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Measuring vulnerability to poverty: An Empirical evidence from Ethiopian Rural Household Survey

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Measuring vulnerability to poverty: An empirical evidence from Ethiopian Rural Household Survey (ERHS)

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Abstract

Poverty reduction policies and strategies implemented in many developing countries like Ethiopia mainly target the current poor and neglect of the vulnerable. An understanding of household vulnerability to future poverty is crucial for sustainable growth and development to such countries. The objective of this study is to assess *ex-ante* welfare of each household from vulnerability to poverty estimates among households in rural Ethiopia and examine the effect of various socioeconomic characteristics on vulnerability to poverty.

This thesis uses a single cross-sectional data set from the year 2009 and the seventh round survey to analyze the welfare of each household using the current real consumption expenditure deflated in 1994 prices. The study employs a three step Feasible Generalized Least Squares (FGLS) estimation procedure to estimate vulnerability to poverty and to predict the effect of household socioeconomic status on expected future consumption and analyze the variations in future consumption.

The results show that, about 51% of households in Ethiopia are vulnerable to poverty that is significantly higher than the current poverty level of about 29%. While the Northern and the southern regions have the highest average vulnerability of approximately 52%, Oromia region has 49% vulnerability to poverty ratio. Household size, possession of livestock, farm size, and off-farm income, amount of rain fall, and basic goods and services received are the variables that significantly impact vulnerability to poverty.

The results suggest that poverty and vulnerability to poverty are independent concepts. Thus, policies concerning poverty reduction need to take into account current non-poor but vulnerable households with the poor households.

Acronyms

ADLI	Agricultural Development Led Industrialization
CSA	Central Statistical Agency
CSAE	Center for the Study of African Economies
CPCR	Real Consumption per Capita
ERHS	Ethiopian Rural Household Survey
ETB	Ethiopian Birr
FGLS	Feasible Generalized Least Square
GDP	Gross National Product
GNI	Gross National Income
GTP	Growth Transformation Plan
HHD	Household
IFAD	International Food and Agricultural Development
IFPRI	International Food Policy Research Institute
MDG	Millennium Development Goal
MoFED	Ministry of Finance and Economic Development
OLS	Ordinary Least Squares
PA	Peasant Association
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PHC	Poverty Head Count
PRSP	Poverty Reduction Strategic Paper
SDPRP	Sustainable Development and Poverty Reduction Plan
SNNP	Southern Nations, Nationalities and Peoples
USD	United States Dollar
VEP	Vulnerability as Expected Poverty
WB	World Bank

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1. Introduction

"Poverty is not an accident. Like slavery and apartheid, it is man-made and can be removed by the actions of human beings" Nelson Mandela

1.1 Background

Located on the eastern part of Africa, Ethiopia is one of the largest sub-Saharan African countries covering 1,138,512 square kilometers. The actual census taken in 2009 indicated on table 1 below shows the size of the population to be 84 million (CSA 2009). In 2007 Children below the age of 15 years comprise of 45% of the total population where 84% still resides in the rural areas (MoFED 2009).

Agriculture is the mainstay of the economy accounting for 83.4% of the labor force, 43.2% of the Gross Domestic Product (GDP) and 80% of exports. The other program called the agriculture Development-Led Industrialization (ADLI) Strategy was adopted in 1993 to 'stimulate the country's economic growth, promote the development of the agricultural sector and improve the lives of farmers through increased productivity' (MoFED 2010a).

Ethiopia has made a fundamental economic progress complemented by a strong performance in the agriculture, industry (construction and manufacturing) and service sectors. The 2009/10 overall economic performance measured by growth in real GDP is 11.3%. The average growth in agriculture, industry and service sectors was 10.3%, 10.2% and 13% respectively (MoFED 2010b). Accordingly school enrolment and health service coverage rates were remarkably improved at all levels due to the Governments focus in the area (MoFED 2010a).

Regarding results from the improvement, gross enrolment rate in primary education rose from 79.8% in 2005 to 94.2 % in 2010. Primary health service coverage increased from 89% in 2009 to 96% in 2010. Access to national potable water supply rose to 73% and Life expectancy at birth increased by almost five years from 51 years in 1994 to 56 years in 2008 (MoFED 2009/2011).

The 2005-2010 Plan for Accelerated and Sustained Development to End Poverty (PASDEP) recognized the relevance of human rights and endorsed the national action plans on gender equality and children. Furthermore, the Growth Transformation Plan (GTP) 2010-2014 represents a marked improvement and dedicates a separate chapter on children and women (MoFED 2012). These comprehensive poverty reduction strategies are continuing to succeed in registering constant decline in poverty levels, for instance from 49.5% in 1994 to 38.7% in 2004/5 and 29.2 % in 2009/10 (MoFED 2010a)

During the Sustainable Development and Poverty Reduction Plan I (SDPRP) period (2002/03-2004/05), real GDP grew on average by about 5% per annum. However, during 2004-2009 the country registered an average economic growth of 11.4% per annum with steady and strong positive performance in real GDP. This steady growth represents a significant progress to become a middle income country in the coming few years in which this rate surpasses the 7% annual growth rate set by the MDG (MoFED 2011).

Table 1 Macroeconomic and demography

	1988	1998	2009
GDP per capita(USD)	135	118	190
Population			
Total	44.76	-	80.71
Rural total	39.24	-	66.99

Source: FAO World Development Indicators (WDI)

Poverty alleviation has been considered the other side of development. Ethiopia is one of the developing economies that set out poverty eradication program such as poverty reduction strategic paper/ PRSP/ to attain the Millennium Development Goal (MDG) by 2015. MDGs are eight United Nation initiated international development goals established after the millennium summit in 2000 (MoFED 2010b). The goals include:

- Eradicating extreme_poverty_and_hunger,
- Achieving universal primary education,
- Promoting gender equality and empowering women,
- Reducing child mortality rates,
- Improving maternal health,
- Combating HIV/AIDS, malaria, and other diseases,
- Ensuring environmental sustainability, and
- Developing a global partnership for development.

The first goal as a fundamental goal related to this thesis needs a detailed measure of poverty of the rural communities in terms of vulnerability. This analysis will enable identification of the main factors that either directly or indirectly contributes to extreme poverty. Consequently, it will help a systematic formulation of policy measures to eradicate poverty.

A tremendous effort has been made in defending poverty by the current regime to reduce poverty to about 29% in 2010 compared to 49% of the total population living below poverty line in 1994. This indicates that the reduction as part of the goal is heading to the MDG plan of 22% (MoFED 2010b). In contrast to this, some studies indicate that the poverty head count (PHC) ratio is turning its head up again due to the decline in agricultural productivity and slow growth of the service sector (Abraham and Bauer 2012).

According to Table 2 Poverty Head Count (PHC) ratios have substantially declined at the rural, urban and national levels by 32.8%, 23.6 % and 32.1% between the years 1996 and 2011. The decline is mainly attributed to several activities held in the respective group to eradicate poverty. Rural regions such as Afar and Somalia are pastoralist regions that remain very poor over the period due to the impact of frequent drought. Despite these facts poverty is still more of a rural phenomenon than the urban one (MoFED 2012).

Table 2 Poverty Head Count Ratio in Rural and Urban Ethiopia

	1995/96	**2004/05**	**2010/11**	**Change(%)1996-2011**
Rural	0. 516	0. 385	0. 347	-32. 8
Urban	0. 365	0. 353	0. 279	-23. 6
National	0. 495	0. 38	0. 336	-32. 1
Regional States:				
Tigray	0. 561	0. 485	0. 318	-43. 3
Afar	0. 331	0. 366	0. 361	9. 1
Amhara	0. 543	0. 401	0. 305	-43. 8
Oromia	0. 34	0. 37	0. 287	-15. 6
Somale	0. 309	0. 419	0. 328	6. 1
Benishangul	0. 468	0. 445	0. 289	-38. 2

Southern Nations	0. 558	0. 385	0. 296	-47
Gambela	0. 348	na	0. 111	-68

Source: MoFED

1.2 Problem Statement

In many developing countries various research papers have been made to find out the exact measure of poverty based on *ex-post* data sets. The need for further investigation of the measure of vulnerability to poverty other than the crude measure of poverty is suggested by many development economists to trace the root factors that will determine the problems on hand implying to the future.

On the contrary, poverty studies that take into account the prevailing deprivation of the households; this study will mainly analyze the impact of idiosyncratic shocks or a mix of both (covariate shocks and idiosyncratic) shocks on the probability of household to fall below the prevailing consumption level. The relationship between growth and poverty incidence in Ethiopia was studied in-depth by Dercon and his fellow researchers using ERHS longitudinal data. They suggested that the *ex-post* measure and protection mechanism recommended by many of the previous studies is inadequate rather it is the *ex-ante* status of the shocks that will contribute to vulnerability of households (Dercon et al. 2007).

Vulnerability as a magnitude of the threat to poverty and *ex-ante measure* is considered an indicator of poverty as a magnitude of low welfare outcomes observed below some accepted poverty line. Accordingly, it is worthwhile to investigate the observed '*ex-post* measure of a danger of low welfare outcomes without undermining risk issues to the analysis' (Chaudhuri 2000; Hoddinott and Quisumbing 2003 and Dercon et al. 2007). Even though it is preferred to apply panel data in studying vulnerability as expected poverty to shock, it will be potentially informative due to the presence of a limited number of such studies in the country.

As poverty reflects deprivation on various fronts of the society, vulnerability to poverty is assumed to be a good measure of welfare of the society. Certain constraints prevail on upon measure of vulnerability to poverty from cross-section data set due to a limited observation and poor economic techniques to better estimate or increase the power of prediction of the parameters.

Households frequently fall into poverty as a result of an external shock, such as exposure to long-term sicknesses, market volatility, failed harvests, and natural disasters. Other studies most strongly relate household characteristics with vulnerability to poverty. These characteristics such as size of household family members who are dependent measured in terms of dependency ratios (the more children and/or old people present in the household the more exposed to poverty incidences) is found to be one of the important welfare weights to determine vulnerability to poverty. Assets such as land and livestock are also important factors associated to move out of poverty, others such as education, participation in non-farm wage activities and the share of income generated from non-agricultural activities. For instance, in Ethiopia we have a program called Productive Safety Net Programme (PSNP) that provides five days' employment per month for six months, to more than 6.5 million people. Participation in PSNP has meant that significant numbers of beneficiaries are now able to avoid selling food to pay for short-term needs, and many now feel sufficiently secure in their income to take productive loans which they previously found too risky (IFAD 2011).

This thesis will be focusing on poverty defined in terms of consumption more than any other dimensions of poverty, such as education or child mortality which tends to be most closely related to changing economic opportunities. For example, since 1991, there have been considerable improvements in access to education, with primary gross enrollment rates rising from about 19 percent in 1994 to 77 percent in 2009 (Dercon et al. , 2011). Primary education completion rates are lagging behind but have also picked up from 29 percent in 2000 to 37 percent in 2004. Infant mortality also appears to be on the decline, from 204 in 1990 to 166 in 2000 and estimated at 123 in 2005 (World Bank 2006).

Consumption being defined as the sum of values of all food items, including purchased meals and investment on non-food items, consumption of non-food items is less frequently used compared to other welfare measures such as health and education expenditure (Hentschel and Lanjouw 1996). There are good conceptual reasons to include use values for durables or housing goods as part of consumption estimates (Deaton and Zaidi 2002). It was assumed that consumption estimates may understate the actual increases in household welfare. And hence values are better expressed in monthly per capita terms and deflated using the food price index with base year real prices on survey data (Dercon et al., 2007).Consequently, this thesis will be devoted to analysis of vulnerability as expected poverty using econometric indicators

defined in terms of single welfare measure, namely the logarithm of real consumption expenditure.

Therefore, the research problem in this thesis is set forward to vulnerability as expected poverty to be set in terms of an *ex-ante* risk a household will face at least in the short run other than 'the who is who?' cataloging method of poverty analysis made by many scholars (Imai et al. 2007). In this regard one study from World Bank describes that from the total population who are non-poor, the incidence of a single shock may result in another 25% to fall into poverty (World Bank 2005).

Moreover the frequency of the occurrence of various shocks such as climate change is the major shocks that contribute to poverty. For instance, during the period 1900 to 2013, 15 droughts occurred and it affected more than 66 million and killed more than four hundred thousand and damaged an estimated economic value of more than of 93million US Dollars (USD). During the same period an occurrence of more than fifty floods has affected approximately 2.4 million of the people in living in Ethiopia (EM-DAT 2013).

Many studies have been made to examine vulnerability of rural household dwellers in Ethiopia. Skoufias and Quisumbing (2005) employ *ex-post* vulnerability assessment tools to analyze poverty and similarly Deressa et al. (2009) have applied the *ex-post* technique but using a panel data set. Others make analysis of the outcomes related to various shocks on vulnerability using *ex-ante* vulnerability assessment. Thus, as an addition to the existing literature it is appropriate to make use of the approaches applied by the modern development scholars to measure vulnerability of the poor households as expected poverty (Dercon 2004; Dercon et al. 2005; Yamano et al. 2005; Skoufias and Quisumbing 2005; Deressa et al. 2009; Dercon and Krishnan 2000).

1.3 Objectives of the Study and Study Methods

The overall purpose of the study is to examine the effect of various idiosyncratic and covariate shocks on vulnerability to poverty each households.

The specific aims of the study include:

- Measure the vulnerability to poverty based on the rural household characteristics and other variables to investigate the frequency of poorness of each household.

- Identify the determinants of vulnerability to poverty and determine the relation between poverty and Vulnerability as Expected Poverty (VEP) and be able to justify the reasons for poorness.
- To compare and contrast the observed incidences of poverty with vulnerability to poverty to find out the possibilities of threats to vulnerability and hence dangers to poverty.

A quantitative econometric technique will be applied to predict a future situation based on historical real consumption expenditure trends of a given household in the country. The research method used in this project will be treated into three sections. The first part will be a use of descriptive statistics which entails the poverty prevalence in the rural households. The second part of the methodology will make use of econometric analysis technique (Chaudhuri 2000). The three step feasible generalized least square estimator (FGLS) will be used to formulate the equation that will validate vulnerability as expected poverty measure on the basis of Ricardian inter-temporal consumption expenditure normally distributed over the given household.

At the end it will be simple to present the results from the prediction to locate the where about of rural households facing poverty incidences and make distinction between the poor or the non-poor that may need some policy measures to tackle the causes of future poverty. In other words it will be amplified through summary of the core results from the study with the prevailing poverty incidences of the specific period.

1.4 Scope and Limitation of the Study

The importance of measuring vulnerability in Ethiopia is crucial due to the absence of fundamental solution to the risks arising from exposures to shocks (Asfaw and Braun 2004). The other Justification to undertake this thesis also arises from underdevelopment of traditional risk coping institutions such as Iddir (funeral Association), Equib (credit associations), Debo (labor-sharing arrangements), and Mahiber (religious gathering) that affect welfare of the rural households. Hence, it may be easy to consider the above points to be the motives to analyze vulnerability as expected poverty.

In contrary to applying panel data set which has the advantage of richness and length that will enable us to protect measurement errors, cross-section data techniques used in this thesis has

the inability to control such problems to be a good instrument in the data. It fails to account the temporal variability of parameter over time. Furthermore, dependence on vulnerability estimates on only observed from various household characteristics might results in omitted variable or causality bias (Christiansen and Subbarao 2005). Asfaw and Braun (2004) suggested a high measurement error between similar variables such as plot of land possessed and number of livestock owned; health measures and illness are among these household characteristics that will result in measurement error. In addition to this, it may also not possible to determine the samples taken from few villages or only from some parts of the country to be a representative of all. This is due to the fact that Ethiopia has a varied socioeconomic and agro-ecological setup.

1.5 Organization of the Thesis

The thesis is organized as follows. Chapter two provides literature review, both theoretical and empirical on the measure of vulnerability to poverty. It will begin by defining vulnerability, and then explore definitions by different authors that have developed measures of vulnerability to poverty. The concepts of poverty, risk and vulnerability will also be discussed in detail. Furthermore, empirical results pertaining to the measuring of VEP will be summarized. Vulnerability to poverty, both in Ethiopia and other countries with respect to different approaches will be discussed in this chapter. Chapter three outlines methodology employed to analyze the problem. Specification of the consumption process, econometric techniques and estimation procedures required to compare vulnerability measures using vulnerability as expected poverty and compare its validity to vulnerability with the existing static poverty incidence and hence determine the level of vulnerability. Vulnerability as the expected poverty approach is also used to investigate the prediction power of the independent variables in this chapter. So this involves exposition and discussion of the various steps involved in estimating vulnerability and the econometric issues associated with it in detail. The final part of chapter three will give detailed information on the two ideas considered as corner block of this thesis. They are the derivation of the poverty line to show the size of the future poverty and the choice of vulnerability threshold as component to VEP. The fourth chapter will explain the data used and results of the study. This section will illustrate the descriptive statistics and regression results from different models of the paper using tables, graphs and charts. Finally chapter five will discuss results from part four in detail and chapter six will be devoted to conclusion and policy recommendation.

2. Review of Literature

In this part of the study a review of the theories, concepts and definitions of related literatures will be conceptualized. In connection with this definition of important terms such as vulnerability in relation with the concept of the future poverty will be briefly discussed. Conceptual overview of the study area will also be explained under this section of the study. Finally, results from empirical studies will be summarized.

2.1 Theories and definition of poverty and vulnerability to poverty

Under the analysis of poverty, the definition of poverty in terms of vulnerability has taken various forms by various scholars. The sources and the causes for the risk and occurrence of deprivation and the results derived from the incidences of the risk differentiate the meaning of the term. Glewwe and Hall in 1998 identified vulnerability to be structural and the other being market oriented that arises from the interaction of household characteristics and their earning capacity. Others scholars define the term vulnerability from a poverty dynamics point of view as a probability of falling to poverty in the future and/or at least falling once into poverty in one of the period ahead (Pritchett et. al. 2000). Publications from the World Bank put the term vulnerability as a measure of "resilience against a shock – the likelihood that a shock will result in a decline in well-being" (The World Bank 2000)

Chaudhuri in 2003 defined poverty as an *ex post* measure of well-being (or the lack thereof) "not having enough now of something valuable"; and the term vulnerability to poverty be thought of as an *ex ante* measure of well-being, "the probability now of not having enough of something valuable in the future." The presence of risk relates to events possibly occurring beyond the direct control of individuals and households (Dercon and Krishnan 2000). "The fact that the level of future well-being is uncertain, distinguishes the concept of poverty from the notion of vulnerability."(Dercon 2007)

Dercon and Krishnan in 2000 defined poverty as intrinsic value of well-being that emerges from the philosophy that, "being well today is not a guarantee for being well tomorrow". Hence they forward a comment on the concept that both alleviation and prevention strategies to be instruments needed to adopt simultaneously to effectively tackle poverty in the poverty reduction strategies and programs. This subject matter is analogous to treatment of household

members in a given community upon disease outbreak. A parallel treatment must be given to those who are already affected and a preventive measure to be taken to the others who are at risk.

It is worthwhile to summarize the term poverty as a deprivation of a given society at point in time considered as a static measure of welfare. Whereas vulnerability is a concept that takes into account the impact of shocks on the households that are well-off now but will be affected sometime in the future.

2.2 Conceptual Overview and Quantitative perspective

The words of Morduch in 1994 briefly explain the story behind the concept of the subject matter to be a relationship between poverty and income processes as a determining factor that indirectly affects prosperity of the poor. He also justified an appropriate measure of poverty measured from the access to consumption smoothening mechanism as a difficult welfare weight to make a precise measure. The measure of poverty that involves the mean and variance of consumption over time in terms of certainty equivalent consumption observation of poor households that will lead to a study of vulnerability as expected poverty. In this notion, considering the risk aversion mechanics as to be able to identify 'by how far income of the poor become lower from income of the rich and how often the poor are worse off from the poverty situation.' Therefore their consumption can vary over time and thus he said 'vulnerability does not only result from poverty but it can also reinforce the income process which may lead to poverty and diminish the expected welfare of the poor' (Morduch 1994).

According to the recent development economics scholars there are three major approaches to assessing vulnerability to poverty.[1] The first one is Vulnerability as Expected Poverty (VEP). It focuses on the likelihood that well-being will be below the benchmark in the future vulnerability as expected poverty (VEP) (Chaudhuri et. al. 2002; Christiaensen and Subbarao 2001; Pritchett et. al. 2000). Following VEP, vulnerability as low expected utility (VEU) focuses on the magnitude of the difference in welfare/utility associated with a certainty equivalent level of welfare (a benchmark) and the household's own expected welfare/utility (Ligon and Schechter 2003). Lastly, Vulnerability as uninsured exposure to risk (VER) is an *ex post* as-

[1] The detail description and the procedures of the study can be referred to the respective literature indicated in the paragraph.

sessment of the extent to which a negative shock caused a welfare loss and there is no attempt to construct an aggregate measure of vulnerability (Hoogeveen et. al. 2004). All measures have much in common except they differ in their definition of well-being and their treatment of states of the world around the expectation that is termed as the horizontal rule to be above the benchmark (Hoddinott and Quisumbing 2003).

Vulnerability should always be defined relative to some benchmarks. The horizontal line as indicated in figure 1 is the confidence interval of the probability of each household falling within the predefined consumption interval. In contrary, the bold vertical line is a socially accepted minimal norm of value of consumption namely the poverty line, Z (Hoddinott and Quisumbing 2003). Hoddinott and Quisumbing have depicted with the following diagram to explain the idea.

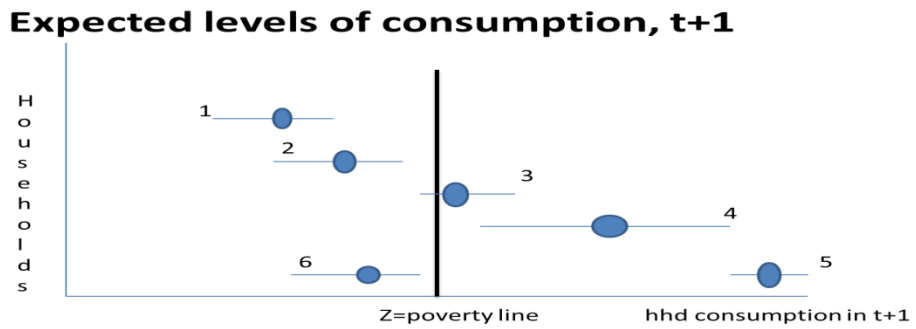

Figure 1 Expected level of consumption

Figure 1 describes four pieces of information:

1. Expectations about consumption (the filled circle);

2. Possible states of the world around that expectation (the horizontal rule), possibly confidence interval;

3. The location of that distribution relative to the poverty line; and

4. The proportion of households characterized by that expected value and possible states.

When *t+1* arrives, some shocks occur, others do not and the outcome of that, together with the factors that affect mean consumption levels yields a distribution of consumption such as that depicted in below. Here Φ is denotes the density of the standard normal distribution function, *z* denotes the poverty line and μ being the mean consumption by each household (Hoddinott and Quisumbing 2003).

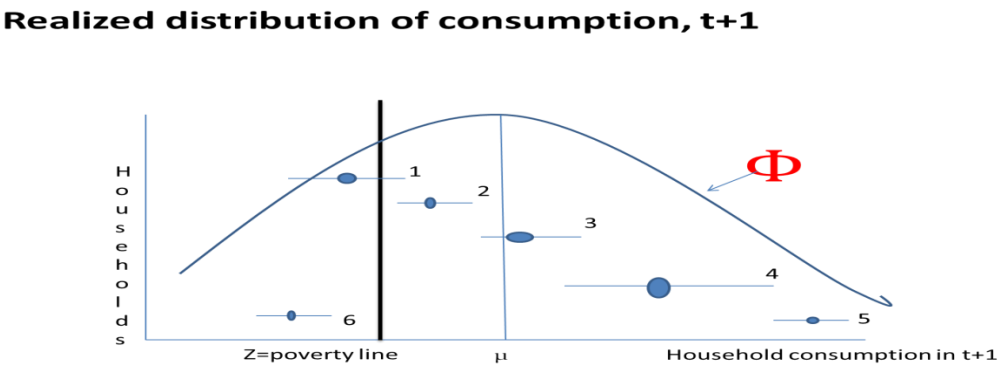

Figure 2 Realized distribution of consumption

Economic tools used to measure vulnerability to poverty can be summarized as follows:

- Consumption (C_h) - is an indicator of well-being (or any other welfare indicators) could be employed upon the availability of data.
- Poverty line(Z)- is a threshold for consumption sometimes called as the 'vertical rule' under the probability density function
- *t+1* - is time horizon over which future shortfalls are assessed. It is to indicate a period of one time ahead.
- Vulnerability threshold (θ)- is a ceiling set (usually 50%) to a household whose probability of shortfall exceeds the threshold classified as vulnerable.
- Density function(Φ) – is the probability density function of consumption to be estimated

2.3 Review of Empirical Literatures

In Ethiopia there are limited numbers of vulnerability studies found on rural households due to lack of rich panel or cross section data for a long period of time. One of the recent empirical literatures related to vulnerability on Ethiopia rural households includes the panel data analysis made by Abraham and Baure in 2012. They have used data from ERHS and their

own primary data from two villages in Ethiopia to analyze the poverty dynamics and vulnerability in the northern highlands of Ethiopia. Consequently they have applied Rodgers 1993 approach used by Jalan and Ravallion (2001). They decomposed household poverty into chronic and transient components using panel data (Abrham and Baure 2012). Abraham and Baure also used the methodology of the fixed effects instrumental variable (FEIV) model and the Multinomial Logit model to control for heterogeneity and for analyzing the factors affecting the probability that a household is in chronic poverty as opposed to transient poverty. Both used the vulnerability as expected approach to enable them to assess poverty dynamics using Foster-Greer-Thorbecke (FGT) measures, components and approaches that resulted in that chronic poverty to be dominant in the study area as compared to transient poor. Using one USD as poverty threshold and 0.5 as vulnerability threshold they find out an existence of decline in one village and an increase in the vulnerability of the households to poverty in the other village. Finally, vulnerability to poverty and its determinants are examined using three step feasible generalized least square and ordinary least square techniques respectively.

Dercon and Krishnan in 2000 contributed a great deal of the poverty measure of the rural livelihood in the Ethiopian context. Using data from ERHS and Consumption as a welfare indicator and considering nutrition as a durable good, they examined the ability of individuals to smooth their consumption over time and/or within the household. They found that there was a great variation in the consumption, especially for the poor and for women in the southern parts of the country. They also reported full risk sharing of illness, measured by unpredicted illness shocks, within households except for poor southern households, where the shocks of women were not pooled (Dercon and Krishnan 2000).

However, even if the data source is the same and their objectives are closely related, it differs from the related studies in that the use of food and non-food consumption as dependent variables helps them examine the effect of consumption level of each households on various consumption related explanatory variables. Also the focus on the household and the village levels as units of analysis will enable to thoroughly investigate the coping capacity of each household's consumption against shocks.

Recently a review of empirics on vulnerability based on approaches developed by Chaudhuri (2003) reveals that a measure of vulnerability called vulnerability as expected poverty is widely used. Suryahadi et al. (2000) define vulnerability as "the risk a household will fall into

poverty at least once in the next few years." They found out that the number of people predicted to be vulnerable are much higher the observed poverty level when poverty line is set at one USD per day. However the predicted vulnerability and observed poverty become more or less the same when the poverty line is assigned to two USD per day.

Ligon and Schechter (2003) also developed a measure of vulnerability using a utility approach. They measure welfare loss associated with poverty and different sources of uncertainty. They applied their approach to a panel data from Bulgaria and they found out the importance of risk to vulnerability. They further noted that poverty and risk play equal role in reducing household welfare.

Others such as Günther and Harttgen (2009), Christiaensen and Subbarao (2005), Hoddinott and Quisumbing (2003), and Christiaensen (2000) have studied the relative impact of shocks on household vulnerability to poverty.

The empirical studies of the pioneer scholars are summarized in Table 3.

Table 3 Potential scholars and their study methods

Scholars	Study methods
Christiaensen(2000)	Pseudo Panel Simulation
Chaudhuri(2002)	Cross-sectional Data Analysis
Ligon and Schechter(2003)	Panel Data Analysis
Tesliuc and Lidert(2004)	Pure Shock Analysis
Hoogeveen(2004)	Census Data Analysis

2.4 Concluding Remarks

Vulnerability as Expected Poverty (VEP) is a widely accepted development economics concept. Many studies have contributed to the theoretical as well as the empirical literatures in different countries. The scholars such as Chaudhuri, Christianson and Ligon and Schechter others made a great share to this study area.

Vulnerability as expected poverty being defined as an *ex ante* risk a household will face at least in the short run is more than 'the who is who?' cataloging of the population in specific area. Methods of poverty analysis and the frequency of the occurrence of various shocks such

as climate change has increased these studies that will assist us to identify the impact of various shocks on vulnerability using *ex-ante* vulnerability assessment.

Thus, this study will be devoted to analyze vulnerability as expected poverty using econometric indicators defined in terms of single welfare measure namely real consumption expenditure.

3. Methodology

3.1 Specification of the Consumption Process and estimation of VEP

This section is devoted to the explanation of the specification of the consumption process in determining the level of assessment vulnerability to poverty. Following his 2002 publication, Chaudhuri has articulated the study of vulnerability to poverty with various examples from countries such as China, Indonesia and Philippines. The level of vulnerability at time t is defined in terms the household consumption prospects at some point in time *t+1* to make an important distinction between the notion of vulnerability and poverty (Chaudhuri 2003). He therefore defined the word vulnerability as forward looking or *ex ante* measure of household well-being and/or security whereas poverty defined as *ex post* measure termed as *'lack thereof'*. *T*he implication for this definition is to clearly identify the current poverty status of each household but not the level of vulnerability to poverty. In other words investigation of vulnerability of each household to future poverty is made without direct reference to the current poverty incidence.

The study of household's vulnerability to poverty is mainly determined using the inferences made from the future consumption prospects. Hence, measuring vulnerability to poverty based on inter-temporal consumption pattern in any period from cross section data requires a number of factors such as wealth, current income, expectations of future income (i.e. lifetime prospects), the uncertainty regarding the future income and ability to smooth consumption in the face of various income shocks (Chaudhuri 2003). Each of them will in turn depend on a variety of household characteristics that are observable and possibly some that are not, as well as a number of features a household finds itself such as total environmental, macroeconomic or socio-political features. A reduced form to describe the future consumption of the conceptual level is as follows:

$$\mathbf{C_{ht} = c\ (X_h, \beta_t, \alpha_h, e_{ht})}$$

where X_h represents a bundle of observable household characteristics, β_t is a vector of parameters describing the state of the economy at time t, and α_h and e_{ht} represent an unobserved time-invariant household-level effect, and other factors (shocks) that contribute to differential welfare outcomes for households respectively (Chaudhuri 2003).

A household's vulnerability to poverty is a non-linear function of its future consumption level. It will depend on forward looking mean consumption level and the variance of inter-temporal stream of consumption (Chaudhuri 2003).

Chaudhuri in his studies (Chaudhuri 2002 and 2003) explained estimates of the consumption process to fundamentally measure household vulnerability to poverty. This requires not only an estimation of its expected consumption in the future, but also prediction from the distribution of its future consumption. He therefore suggested a minimum requirement to estimate the variance of its future consumption from normal distribution captured from the mean and variance of the level of current consumption level. The following sections will illustrate the key estimation procedures in the specification of the consumption process.

3.2 Econometric Models and Estimation Methods

The research methodology in this study will apply a research method used by Chaudhuri in 2002 and 2003. He proposed an estimation of expected mean and variance in consumption using cross-sectional data. This method has been applied by a number of researchers on vulnerability studies in measuring poverty. The main hypothesis is that the error term in a cross-sectional consumption regression, or in other words the unexplained part of households' consumption, captures the impact of idiosyncratic and community specific covariate shocks, and that this cross-sectional variance also reflects inter-temporal variance in consumption (Gunther and Harttgen 2006). Furthermore it is assumed that this variance in consumption can be explained by employing household and community characteristics. The impact of shocks on consumption fluctuations is correlated with observable variables. Given that the vulnerability level of a household *h* at time *t* defined as the probability that the household will find itself consumption poor at time *t+1*, we specify vulnerability to consumption poverty using the models suggested below. In this notion of study, measure of vulnerability as expected poverty following Chaudhuri (2000), is the probability of household, *h* finding itself to be consumption poor at time *t+j* can be expressed as :

$$V_h = P_r\,(lnC_h < lnZ|X_h)$$

, where lnC_h measures the logarithm of household's real per capita consumption expenditure at time *t+j* and *Z* is an appropriate consumption benchmark (poverty line). The probability that a household will find itself poor depends not only on its expected (mean) consumption

but also on the volatility (i.e., variance, from an inter-temporal perspective) of its consumption stream.

Chaudhuri *et al.* (2003) developed a methodology for estimating vulnerability to poverty using cross-sectional dataset. Accordingly a household's vulnerability to poverty defined as a probability condition representing 'its inability to attain a certain minimum level of consumption in the future'.

Therefore, both estimates (household expected consumption and the variance of its consumption) are required to quantify the level of household's vulnerability to poverty. Assuming that the stochastic process generating the consumption of a household $\boldsymbol{h}$ to follow the log-normal distribution is given by:

(1) $$\boldsymbol{lnC_h = X_h\beta + e_h}$$

Where $\boldsymbol{C_h}$ is a log normally distributed real consumption expenditure, a household's $\boldsymbol{h}$ consumption expenditure in period t is determined by a set of observable household characteristics, including assets and other risk management instruments $\boldsymbol{X_h}$, and $\boldsymbol{\beta}$ is the $K\times1$ vector of parameters of interest and $\boldsymbol{e_h}$ is $F\times1$ vector of unobservables. The $\boldsymbol{e_h}$ is a mean-zero disturbance term that captures observable community level chararacterstics and/or unobservable characteristics that contribute to different per-capita consumption expenditures of households considered on similar status. Hence, Equation (1) explains the variables between $\boldsymbol{C_{h1}}; \ldots; \boldsymbol{C_{h}}_{\mathrm{F}}$ in terms of $\boldsymbol{X_h}$ and the unobservables, $\boldsymbol{e_h}$.

In this case it is necessary to make two important assumptions because vulnerability is estimated from a single cross-section data. First, it is assumed that the idiosyncratic shocks to consumption are identically and independently distributed over time for each household. This implies that unobservable sources of persistence arising for example, from serially correlated shocks or unobserved household specific effects over time in the consumption level of an individual household are ruled out. Following the first assumption it is necessary to assume the structure of the economy captured by the vector $\boldsymbol{\beta}$ to be relatively stable over time. This will rule out the possibility of aggregate shocks representing unanticipated structural changes in the economy. By assuming a fixed $\boldsymbol{\beta}$ over time, the implication that the uncertainty about future consumption stems solely from the uncertainty about the idiosyncratic shock $\boldsymbol{e_h}$, the

household will experience in the future. Usually the error term $\boldsymbol{e_h}$ is also assumed to reflect the measurement error of households' consumption pattern (Chaudhuri 2003). In contrast, Chaudhuri (2002) assumes that the error term $\boldsymbol{e_h}$, or the variance in consumption of otherwise equal households to reflect the impact of idiosyncratic shocks on households' consumption. In other words, the inter-temporal variance of consumption expenditure depends on certain household characteristics and a simple functional form used to relate variance of the consumption function and household characteristics. Chaudhuri further assumes the variance of the disturbance term is not identically distributed across households. This is to avoid the possibility of the poor households that could face greater levels of consumption volatility. It rather depends upon some observable household characteristics to enable the formation of heteroscedasticity by specifying the following functional form (equation (2)) that directly enter into a measure of vulnerability.

The variance of $\boldsymbol{e_h}$ is assumed to be represented by:

$$(2) \qquad \boldsymbol{\sigma^2_{e,h} = X_h \theta}$$

As it is explicitly assumed that the mean zero disturbance term $\boldsymbol{e_h}$ is heteroscedastic and not homoscedastic in which the usual regression techniques may yield estimates that are inefficient but not bias in the main parameters of interest.

Thus, as proposed by Amemiya (1977) Chaudhuri (2002) suggested using a three-step Feasible Generalized Least Squares (FGLS)[2] regression technique to obtain the population parameter estimates $\boldsymbol{\beta}$ from equation (1) and $\boldsymbol{\theta}$ from equation (2). Starting with equation (1) and applying ordinary least squares (OLS) technique, the estimated residuals $\boldsymbol{e_h}$ from equation (1) are then regressed on $\boldsymbol{X_h}$ using OLS. In other words the OLS estimation of residuals from equation (1) is used to determine the following OLS estimation of the residuals:

$$(3) \qquad \boldsymbol{\hat{e}^2_{OLS,h} = X_h\, \theta + \mu_h}$$

[2] See Chaudhuri (2003), Chaudhuri et al. (2002), and Hoddinott and Quisumbing (2003b) for technical details.

Then, the predicted values from this auxiliary regression, $\boldsymbol{X_h\,\widehat{\theta}}$ are then used to transform equation (3) into:

(4) $$\frac{\hat{e}^2_{OLS,h}}{X_h\,\widehat{\theta}_{OLS}}=\left(\frac{X_h}{X_h\widehat{\theta}_{OLS}}\right)\boldsymbol{\theta}+\frac{\mu_h}{X_h\widehat{\theta}_{OLS}}\;=\boldsymbol{X_h\widehat{\theta}_{FGLS}+u_i}$$

Where, $\boldsymbol{X_h\widehat{\theta}_{FGLS}}$ is a consistent estimate of the variance of idiosyncratic component from equation (2), $\boldsymbol{\sigma^2_{e,h}}$ and the transformed equation is estimated using OLS, and the estimated coefficients from equation (4) are the asymptotically efficient FGLS estimator of the variance of household consumption. Then the estimate from the variance can be re-written as:

(5) $$\widehat{\sigma}_{e,h}=\sqrt{\boldsymbol{X_h\widehat{\theta}_{FGLS}}}$$

We then use the estimated variance $\boldsymbol{X_h\widehat{\theta}_{FGLS}}$ to transform equation (1) into:

(6) $$\frac{\boldsymbol{lnC_h}}{\sqrt{\boldsymbol{X_h\widehat{\theta}_{FGLS}}}}=\left(\frac{\boldsymbol{X_h}}{\sqrt{\boldsymbol{X_h\widehat{\theta}_{FGLS}}}}\right)\boldsymbol{\beta}+\frac{\boldsymbol{e_h}}{\sqrt{\boldsymbol{X_h\widehat{\theta}_{FGLS}}}}$$

Again the OLS estimation from the equation (6) will give us a consistent and efficient estimate of $\boldsymbol{\beta}$. The standard error of the estimated coefficient, $\hat{\beta}_{FGLS}$ can be obtained by dividing the reported standard error by the standard error of the regression from equation (5). Finally using the estimates of $\hat{\beta}$ and $\hat{\theta}$ that we obtain from equation (6) we will be able to determine expected log consumption and variance of log consumption to each household *h*.

The expected log consumption:

(7) $$\boldsymbol{\widehat{E}\,[(lnC_h\,|\,X_h)]=X_h\,\widehat{\beta}}$$

and

The variance of log consumption:

(8) $$\widehat{Var}[lnC_h \mid X_h] = \hat{\sigma}^2_{e,h} = X_h\hat{\theta}$$

As indicated at the beginning of this section the log normally distributed consumption is an estimate of the probability a household to either be poor or not known as vulnerability as expected poverty is given by:

(9) $$\hat{V}_h = \Phi\left(\frac{ln\, Z - X_h\widehat{\beta_{FGLS}}}{\sqrt{X_h\hat{\theta}_{FGLS}}}\right)$$

where $\Phi(.)$ represents the cumulative normal distribution function, **z** represents the poverty line that is considered to be the minimum consumption level below which each household is assumed to be vulnerable, $X_h\hat{\beta}_{FGLS}$ is the expected mean of real household consumption, and $X_h\hat{\theta}_{FGLS}$ is the estimated variance in consumption.

Therefore, the measure of VEP analysis depends on such factors as the distributional assumption of normality of log consumption, the choice of poverty line, the expected level of log consumption and the expected variability of log consumption. The functional relationship of the elements in equation (8) indicates that level of vulnerability to poverty to reduce as expected consumption and expected consumption variability increases.

As an extension to this section on techniques in estimating the parameters from cross-section data set, the following expanded expression will clarify the steps that will enable us in the application of econometric estimation techniques to forecast the future consumption and the probabilities of each household to slip into poverty depending on the vertical, horizontal rule and the vulnerability threshold explained in chapter two. Hence, the following functional form is used to estimate θ for the model of real consumption function expenditure showing the existence of heteroscedasticity. So it will be easy to show the expanded form of expression from equation one to estimate using the three-step FGLS regression method. The variance in equation two can again be expressed as:

(10)

$\boldsymbol{var}$=($\boldsymbol{\theta_0}$+ $\boldsymbol{\theta_1}$gender+ $\boldsymbol{\theta_2}$hhsize+ $\boldsymbol{\theta_3}$age+ $\boldsymbol{\theta_4}$agesq+ $\boldsymbol{\theta_5}$lstockv+ $\boldsymbol{\theta_6}$cropa+ $\boldsymbol{\theta_7}$cropa2+ $\boldsymbol{\theta_8}$infcom mn+ $\boldsymbol{\theta_9}$schyr+ $\boldsymbol{\theta_{10}}$timefwf+ $\boldsymbol{\theta_{11}}$sickdays+ $\boldsymbol{\theta_{12}}$offarminc+ $\boldsymbol{\theta_{13}}$creditamt+ $\boldsymbol{\theta_{14}}$tramt+ $\boldsymbol{\theta_{15}}$mrainm m2+ $\boldsymbol{\theta_{16}}$mrainmm3+ $\boldsymbol{\theta_{17}}$mrainmm4+ $\boldsymbol{\theta_{18}}$mrainmm5+ $\boldsymbol{\theta_{19}}$consmpoor)^2

This will lead us to the first on hand prediction of the residuals that will allow us to determine the variances of the logarithmic consumption expenditure that is regressed through the ordinary least square technique. The integer values of the residuals being expressed in absolute terms, in other words the absolute value of the predicted variance can be shown as follows:

(11)

$|\widehat{\boldsymbol{var}}|$=$\boldsymbol{\theta_0}$+ $\boldsymbol{\theta_1}$gender+ $\boldsymbol{\theta_2}$hhsize+ $\boldsymbol{\theta_3}$age+ $\boldsymbol{\theta_4}$agesq+ $\boldsymbol{\theta_5}$lstockv+ $\boldsymbol{\theta_6}$cropa+ $\boldsymbol{\theta_7}$cropa2+ $\boldsymbol{\theta_8}$infcom mn+ $\boldsymbol{\theta_9}$schyr+ $\boldsymbol{\theta_{10}}$timefwf+ $\boldsymbol{\theta_{11}}$sickdays+ $\boldsymbol{\theta_{12}}$offarminc+ $\boldsymbol{\theta_{13}}$creditamt+ $\boldsymbol{\theta_{14}}$tramt+ $\boldsymbol{\theta_{15}}$mrainm m2+ $\boldsymbol{\theta_{16}}$mrainmm3+ $\boldsymbol{\theta_{17}}$mrainmm4+ $\boldsymbol{\theta_{18}}$mrainmm5+ $\boldsymbol{\theta_{19}}$consmpoor + U_h

where the predicted values of $\hat{\boldsymbol{e}}^{\boldsymbol{2}}_{\boldsymbol{OLS,h}}$can be used to approximate the predicted standard deviation represented as follows:

(12) $\widehat{\boldsymbol{\sigma}}_{\boldsymbol{OLS,h}}$=$|\widehat{\boldsymbol{var}}|$

The steps prior the FGLS analysis is summarized as follows:

- Estimate equation (1) using OLS and then obtain the residual from. This requires the prediction of the residuals, $\hat{\boldsymbol{e}}^{\boldsymbol{2}}_{\boldsymbol{OLS,h}}$ from the estimation
- Absolute values of the residuals ,$\left|\ \hat{\boldsymbol{e}}^{\boldsymbol{2}}_{\boldsymbol{OLS,h}}\right|$ is also required
- Estimate equation (11) through auxiliary OLS econometric technique will enable us to predict the fitted values of the standard deviation to equation (12)
- Finally estimation and computation of the expected values and variance of the log real consumption expenditure at time *t* will guide us to establishment of the basic outputs of the FGLS process and analysis of the major factors contributing to vulnerability of each household to be poor.

Robust estimation of the model

The techniques used in the estimation of the regression model and the robust standard models will simplify the analysis of the FGLS using the equations in section 3.2. This in turn will enable us to estimate the most efficient welfare analysis technique as proposed by Chaudhuri (2003). At this stage the application of predicted fitted values of the after auxiliary estimation of the equation (11) is used as a weight (equation 6). This will enable us to transform equation (1) by dividing it with $\sqrt{\boldsymbol{X_h\hat{\theta}_{FGLS}}}$ and then run OLS to get a consistent and asymptotically efficient feasible estimate of FGLS conditional expected mean and variance of log real consumption expenditure. Using the population parameters $\boldsymbol{\beta}$ and $\boldsymbol{\theta}$ estimated above we will calculate the log of real consumption expenditure and variance of log of consumption expenditure for each household estimated respectively as shown in section 3. Predicted standard error obtained by estimation in equation (5) has two important roles. First it is used in estimating equation (1) by FGLS regression technique and on the other hand we use it in the determination of the values of the vulnerability to poverty.

As we have defined vulnerability in the previous chapters, at time *t,* it is defined as the probability of falling below a given threshold level of consumption expenditure as a measure of welfare in the next period *t+1*. In this case, we assume the log consumption expenditure of both food and non-food expenditures normally, independently and identically distributed to estimate vulnerability as expected poverty for each household based on the survey dataset from ERHS as depicted in equation (9).

3.3 Derivation of the poverty line

A cost-of-basic-needs approach is applied estimate of the levels and changes in poverty in setting a poverty line. According to the World Bank reports a cost-of-basic-needs approach to poverty refers to a food poverty line is constructed using a cost of a bundle of food items that would provide 2300Kcal per adult per day (The World Bank 2000). To this effect we add a non-food bundle using the method set out in Ravallion in 1996 as was cited by Dercon and Krishnan (1996, 2003) to construct the poverty line which includes details of the food basket and its sensitivity to different sources of data on prices used to value the food basket. In this case the poverty line used in this thesis is 50 birr per capita per month deflated in 1994 prices (Dercon et al. 2005).

In Ethiopia total poverty line used since 1995/96 is 1075 Ethiopian (Birrs) currency expressed in terms of national average prices. Therefore, the food and non-food consumption expenditure is used as dependent variables and other demographic and social characteristics from Ethiopian rural the household survey data set is used to represent the independent variables in the analysis to measure of vulnerability of the rural households to poverty.

3.4 Choice of vulnerability threshold

As we have explained in section 3.2 the estimation of vulnerability to poverty depends on such factors as the statistically distributional assumption of normality of real log consumption, the choice of poverty line, the expected level of log consumption and the volatility of log consumption. Vulnerability to poverty will decline as the expected mean and variance of the real consumption increases.

A threshold measure that is used in this thesis is vulnerability of households that have an estimated vulnerability coefficient greater than 0.5 (Chaudhuri et al. 2002). The choice of 0.5 is justified for two reasons. The first reason is that it makes intuitive sense to say that a household is vulnerable if it faces a 0.5 or (50%) or higher probability of falling into poverty in the next period. Secondly, as argued by Pritchett and others (2000), when a household whose current level of consumption is equal to the poverty line, it faces a zero mean shock which has a one period ahead vulnerability of 0.5. This in turn leads to an assumption that as the time horizon approaches zero, being currently poor and being vulnerable to poverty coincide.

The set of initial regressors includes a host of explanatory variables which are both discrete as well as continuous. These regressors are essentially household-level variables focusing on: household assets, education levels and literacy, employment, household facilities, household structure, demographic characteristics and geographical location. These variables were constructed from the Ethiopian rural the household survey (ERHS). Optimal predictors are selected using a combination of traditional regression statistics and test for correlation, prediction and multi-collinearity. A rural consumption function is selected for the vulnerability assessment due to a better predictive power.

Generally, the appropriate VEP threshold employed under this analysis will follow the standard vulnerability to poverty threshold as a 50 percent or higher probability to fall below the poverty line proposed by various scholars (Pritchett et al. 2000; Suryahadi et al. 2000; Chaudhuri 2002; Jalan and Ravallion 2001; Zhang and Wan 2008).

4. Data and Analysis of Results

4.1 Data

Ethiopia is a federal country divided into eleven regions in which each region is sub-divided into zones and the zones into *Woredas*. *Woredas* are in turn divided into Peasant Associations (PA)[3], or *kebeles*, an administrative unit consisting of a number of villages Peasant association. In other words *kebele* is the smallest unit of administration setup after the takeover of the former government in the country during 1974.

The data in this thesis is based on the Ethiopian rural household survey (ERHS), a rich panel dataset conducted by Addis Ababa University in collaboration with IFPRI and CSAE (university of Oxford) since 1989. In 1994 the survey was expanded to cover 15 villages across the country (Appendix 2). An additional round was conducted late 1994, with further rounds in 1995, 1997, 1999, 2004 and 2009. In addition, nine new villages were selected giving a sample of 1477 households. The nine additional communities were selected to account for the diversity in the farming systems in the country, including the grain growing areas of the Northern and Central highlands, the *ensete* growing areas and the sorghum-hoe areas. Topics discussed in the survey include household characteristics, agriculture and livestock information, food consumption, health, women's activities, as well as community level data on electricity and water, sewerage and toilet facilities, health services, education, non-government organization activity, migration, wages, and production and marketing (Appendix 2).

Accordingly this thesis investigates the welfare of five peasant associations (PA_s) that are carefully selected from different parts of the country based on common population characteristics, different geographical location, various rainfall distributions and past and present incidence of poverty. This will enable the results to be representative of their respective region in particular and the country in general. Meanwhile this thesis uses a single cross-sectional dataset from the year 2009 and the seventh round survey to analyze the welfare of each household using the current real consumption expenditure. The survey contains data on consumption, asset and income on about 376 households from five peasant associations selected from

[3] In Ethiopia, the smallest unit of administration is the Peasant Association (PA), an administrative unit of one or a small number of villages. Thus, in this thesis "Peasant Association" and "village" are used interchangeably.

four major regions of the country. The data set constitutes 65, 130, 89 and 92 households from Tigray, Amhara, Oromia and SNNP regions respectively. The household from Amhara region comprises of two different PAs to account for one favorable peasant association and the other fulfilling the basic peasant association selection criteria to measure vulnerability as expected poverty. Justifications for the selection of major village characteristics from the survey area include: similarities and/or variations in demographic status; health status; assets ownership; educational level; occupation status of members of the household and consumption behavior of the communities. In addition to this other behavioral characteristics such as social integration of the village in the community, socio-economic and demographic characteristics, system of information and communications technologies, transport system, market facilities are some of them that are taken into account to accurately validate the analysis. This might be a good strategy for the results to be representative of the country in coordination with the major characteristics of the villages.

4.2 Definition of variables

Based on theoretical exposition and concepts articulated in this thesis the explanatory variables which have economic relevance to assess the measurement of vulnerability to poverty are listed below. Monthly real consumption expenditure per adult equivalent deflated by 1994 prices is the dependent variable in the VEP analysis of the regression model is specified under this section. The variable representing welfare of the households to measure the response of an *ex-ante* poverty status of the households includes both food and non-food consumption expenditure valued in Ethiopian currency, *Birr*.

The selection of the household characteristics follows the guidelines submitted by the scholars Chaudhuri (2002); Hoddinote and Quisumbing (2003) for a given household. They specifically represent a set of observable household characteristics to be fixed, at least in the short run. Accordingly in the model specification some relevant variables are chosen based on demographic, health, occupation and amount of major asset possessions based on rural household characteristics.

Table 4 contains a set of variables listed in the order of importance and availability of the data set from the sources. The first approach suggested by Hoddinote and Quisumbing (2003) and a method proposed by Chaudhuri (2000) will be applied to identify the vulnerable group with-

in the households. Hence it is wise to use demographic household characteristics and community level characteristics as observable variables to determine their effect on the level of consumption and vulnerability. The dependent variable is log consumption per capita expenditure. The independent variables are broadly categorized into demographic status, health status, assets ownership, educational level and occupation status of members of the household.

Table 4 Definition of Variables

Variable name	Definition of variables
lncpcr	log real consumption per capita deflated by 1994 prices
gender	Gender of the household head
hhsize	Number of members in the household
age	Age of the household head
agesq	Age squared of the household head
lstockv	Nominal value of livestock
cropa	Plot of area owned for the selected major crops
cropasq	Crop area owned for the selected major crops squared
infcommn	Dummy explaining possession of either radio and/ or cellphone
schyr	Years of schooling of the family head
timefwf	Time spent to fetch water and fuel wood
sickdays	Number of days HHD head gets sick or injured during the month
offarminc	Monthly off-farm income
creditamt	Amount of credit received during the month
tramt	Transfer received from remittances during the month
mrainmm1	Average rain in mm, Geblen
mrainmm2	Average rain in mm, Dinki
mrainmm3	Average rain in mm, Yetmen
mrainmm4	Average rain in mm, Adele keke
mrainmm5	Average rain in mm, Gara Godo
consmpoor	Consumption poor

Notes: HHD= Household
The variables are mostly associated with either growing incidence of poverty or with decreasing incidence of poverty.

Gender of the household head: is a dummy variable which takes the value 1 if the household head is male and 0 otherwise. It can affect consumption of a household in either ways.

Household size: The impact of household size has a varied nature on the on well-being and demographic composition of households. It is expected to affect the dependent variable in either ways depending on the demographic composition of the household. Therefore, its effect might be positive if larger household size means more working force where the household constitutes a larger number of working age and hence less dependency ratio and negative if it implies higher dependency ratio.

Age and age squared of the household head: Age generally is expected to affect consumption positively. As the age of the household increase the household acquires more experience, skill and accumulate asset that will negatively impact vulnerability to poverty. In contrary, the age squared variable intends to capture the negative effect on consumption is may be due to a decrease in labor supply to the household and a poor decision capacity of the head with an increment in age.

Nominal value of livestock: It refers to the value of total livestock assets that could be used as oxen ploughing technology in farming, income received from their products and their dung used as a fuel or organic manure to increase production in agriculture. Hence, livestock asset is expected to negatively relate with lower vulnerability of each household to poverty serving as a coping mechanism in the time of risk.

Crop cultivation area and crop area squared: It refers to the total land in hectares owned by the household used for cultivating crops and fodder for livestock. It is expected to be positively with the welfare indicator of the household. And the square is to capture the effect more area possession in the consumption.

Information and communication: It is a dummy variable that captures whether a household head possesses mobile or cell phone and/or radio as symmetric information tool for good marketing and consumption decision.

***Years of schooling of the household Head*:** It is a variable that refers to the number of years spent in schools or its equivalent as a measure of educational attainment of the household head and it is expected to affect the welfare of the household positively.

Time to fetch water and fuel: It is a variable that captures the impact of time spent to collect fuel wood and water on the consumption behavior of the households. It will positively affect the dependent variable if the wood is sold or the water fetched used to produce for consumption purpose and negatively affect consumption of each household, if the time is spent on this activity decrease agricultural production, the main income generating activity.

***Sick days of the household head*:** It refers to the number of head of the household days absent from duty on the farm and other activities or the previous major farming season due to

illnesses or injuries. It is expected to exacerbate the probability of households being vulnerable to poverty. Illness is measured by self-reported symptoms and injuries of the household head within a month before each survey.

Off-farm Earning: It is a dummy variable which takes the value 1 if the farmer is engaged in any off-farm activity that generates a significant income and 0 otherwise. It then is expected to positively affect the welfare of the households.

Credit amount: This variable captures amount any of credit a household received during the month. It is expected to be associated with higher consumption expenditures.

Transfer amount: It captures both private transfers and government direct transfers in both forms (cash and kind). Empirical evidences show a varied effect of transfer amounts on the well-being of each household (Tsehay and Bauer 2012 as cited in Kanbur et al. 1994; Mangiavacchi and Verme 2011). Tsehay and Bauer further described 'transfers to be advantageous in serving households get out of deprivation in the short run but their long run impacts' to have been widely questioned. They explained that 'many evidences indicating the negative impact of transfers by creating dependency syndrome and hence making household decrease labor supply'. Therefore, it can be concluded from the above justification that this variable is expected to affect the well-being of each household to in either direction in process.

***Average rainfall in mm*:** It is community level variable indicating an equal distribution of rain to the respective village. It is expected to positively impact the welfare of the household.

Consumption poor: It is a dummy variable that takes value 1 if the household faces three or four of the poverty indicators in the data set to be in a poorest of the poor status in terms of poverty perception, food, healthcare and housing 0 otherwise. This variable will grasp the compound effects that arise from the supply and composition the above listed items. Accordingly the sign might be positive or negative.

4.3 Descriptive statistics

As indicated in Table 5 the comparative statistics such as the average size of households is found to be five per household and the average sick days of the heads being three during the month. Average monthly household consumption expenditure on food and non-food items is fifty one Ethiopian *Birr* and average age of the household head is found to be 53 years.

Table 5 Summary of Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Household size	376	5.194149	2.462967	1	13
Gender	376	.5797872	.4942506	0	1
Age of household Head	376	53.427	14.93788	18	100

Livestock value	376	6026.491	6893.801	11.0001	45501
Plot of land size in ha	376	1.536525	.7223286	1.0001	5.0251
Informatoon and comm	376	.5106383	.7623778	0	4
School years of Head	376	1.396277	2.092498	0	13
Time to fetch water and fuel	376	112.0294	760.5108	1.0001	10006
Sickdays of head	376	3.26606	9.59997	1.0001	15.0001
Off farm income	376	38.8864	61.11486	1.0001	380.5001
Average rainfall in mm	376	1086.753	407.0326	504	1664
Credit amount	376	432.5294	954.377	1.0001	12001
Transfer amount	376	62.61663	185.1174	1.0001	2019
Consumption poor household	376	.2406417	.4280458	0	1
Real consumption exp.(All)	376	51.34175	38.28825	4.595909	230.1883
Region					
Tigray	65	27.79929	10.77105	6.279861	57.78961
Amhara	130	55.59531	31.7705	4.595909	173.9812
Oromia	89	83.47251	47.64889	24.66203	230.1883
SNNP	92	30.88154	21.87452	6.875812	121.7059
Peasant Association(PA)					
Geblen	65	27.79929	10.77105	6.279861	57.78961
Dinki	79	45.44526	27.86568	4.595909	173.9812
Yetmen	51	71.31794	31.27149	22.11496	168.095
AdeleKeke	89	83.47251	47.64889	24.66203	230.1883
GaraGodo	92	30.88154	21.87452	6.875812	121.7059

Source: Own calculation

4.4 Determinants of Vulnerability to poverty

The model estimating r determinants of vulnerability to poverty in this section is in compliance with the assumptions articulated in section 3.2. The residuals with a property of a mean-zero disturbance term captures the existence of unobserved household specific effects over-time. The variance of the residuals e_h however is not identically distributed across the households but depends on observable household characteristics. The figures which are displayed in Appendix 3 clearly show that the estimated residuals obtained after having taken of the effects of the household-specific characteristics seem to satisfy the properties of normal distribution and constant variance.

Vulnerability to poverty is found to be lower among households with larger number of family members as shown in the negative relationship with expected consumption at 1% level of significance. This is means that current large family size to be a good labor force for the household in the future that will undermine vulnerability to poverty.

Possession of a larger number of livestock is one of the determining factors on the consumption of food and non-food items of a given household. This variable affects the consumption level positively at a 5% level of significance. This can be explained in terms of liquidity of their livestock asset to easily and possibly convert to monetary value to positively affect the welfare of each household and hence cope up risk against vulnerability to poverty.

Farm plot size variables not significant but the sign as expected, a positive relationship with expected consumption showing a lower level of vulnerability to poverty. The same is true for educational attainment variables measured in terms of years of schooling variable that relates to lower level of vulnerability to poverty.

The other important variable is other income received from activities other than agricultural production as it is shown in the positive relationship at 1% level of significance. It is worthwhile to explain additional income received from such activities to be one of coping mechanisms that could serve as a hedge against the future poverty. The sources of income could be wages received from government developmental projects in the respective region. Often the activities occur during the non-agricultural seasons of the respective regions. The income received from such activities will be directed to basic household consumption expenditure.

The respective regions also solely depend on rain as indicated in the positive relation with logarithmic consumption of each household at 1% level of significance. Favorable rain to the regions implies boost in agricultural production which in turn increase the consumption expenditure of each household in the respective region.

The variable consmpoor negatively affects logarithmic average consumption of each household at 5% level of significance in general. It means most of the households on the observation may face problems to maintain three or four of the poverty indicators to be in a poorest of the poor status in terms of poverty perception, food, healthcare and housing in the data set.

Table 6 Determinants of Vulnerability to poverty

VARIABLES	*Ex ante* mean $\ln C_h$	*Ex ante* variance $\ln C_h$
gender	0.0245	0.0952*
	(0.0728)	(0.0505)
hhsize	-0.0811***	-0.00749
	(0.0131)	(0.00896)
Age	0.00317	-0.00809
	(0.0138)	(0.00845)

agesq	1.48e-06	5.69e-05
	(0.000122)	(7.61e-05)
lstockv	1.04e-05**	-1.89e-06
	(4.75e-06)	(3.01e-06)
cropa	-0.232	-0.0414
	(0.165)	(0.108)
cropa2	0.0471	0.00586
	(0.0314)	(0.0186)
infcommn	0.0475	0.00385
	(0.0483)	(0.0312)
schyr	0.00320	-0.0124
	(0.0166)	(0.0114)
Timefwf	3.84e-05	-1.84e-05**
	(2.78e-05)	(8.10e-06)
Sickdays	-0.000518	0.000554
	(0.00129)	(0.000834)
Offarminc	0.00147***	0.000246
	(0.000455)	(0.000301)
Creditamt	4.00e-05	-2.21e-05
	(3.50e-05)	(2.17e-05)
Tramt	0.000167	0.000134
	(0.000130)	(0.000142)
mrainmm1	-0.0494	0.1283
	(0.108)	(0.1365)
mrainmm2	0.286***	-0.0459
	(0.0917)	(0.0748)
mrainmm3	0.965***	-0.0219
	(0.104)	(0.0779)
mrainmm4	0.961***	0.113
	(0.102)	(0.0784)
mrainmm5	0.0494	0.0926
	(0.100)	(0.0818)
consmpoor	-0.224**	0.0724
	(0.0868)	(0.0677)
Constant	4.834***	0.496*
	(0.440)	(0.282)
Observations	319	319
R-squared	0.544	0.062

Source: own calculation

Notes: Robust standard errors in parentheses.

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

As shown in table 6 above the impact of the variable gender on the *ex-ante* variance of log consumption is positive and will result in higher variations at a 10% level of significance if the head of the household is male implying the dominance of male headed households to resist poverty. Most female headed households in Ethiopia are landless. A detailed study on Ethiopian villages from ERHS data supports this statement (ERHS 1989-2009).

Regardless of the significance, the analysis of variance in table 6 also depicts the existence of a negative relationship with expected variance of consumption to be lower among households with larger family size. As it was justified previously, households with larger family size to negatively relate with vulnerability to poverty due to remarkable contribution of the family members to the production of consumption goods and services.

Even though insignificant, educational achievement negatively relates to future variations in consumption indicating the possibility of those households to adopt new technology to boost their consumption output to the secure the future welfare risk.

The time spent in fetching fuel wood and water is positively but insignificantly related to average future consumption of each household and negatively related to the future variations in consumption at a 5% level of significance. It can also explained in terms the importance of income received from sale of fuel wood and water as input to the locally made beverages and/or food to the community in the nearby market to support the family income.

The impact of off-farm income on the variations to future household consumption is insignificant but positive showing temporary income generated from other sources are unreliable to secure their welfare. Similarly, sick days of the head indicate a negative relationship with consumption indicating lower vulnerability to poverty and higher variations to future consumption.

The average rainfall in millimeter for each village is significant at 1% level depicting a greater effect on vulnerability to poverty. In most cases it is positively related to the variations in future consumption for it one the most important factors to increase rain-fed agricultural production.

In general, rural households with larger family size, other source of income, favorable seasonal rain, larger number of livestock and better access to basic goods and services have low probability of vulnerability to future poverty. However, other variables are found to be insignificant but with the expected of sign the coefficients indicate that these variables can better estimate vulnerability as expected poverty with a better single cross-section data.

4.5 Vulnerability to poverty in Ethiopia

Table 7 summarizes average vulnerability to poverty in Ethiopia estimated to be 51%. The northern and the southern regions were found to have the highest average vulnerability of approximately 52% and sample villages from the central east and eastern regions have about 49% average vulnerability to poverty. This could be linked with variation in the rainfall among various parts of the country. The respective vulnerability of the sample villages is proportional to the region vulnerability.

Table 7: Vulnerability to poverty profile

	Mean vulnerability (%)	Mean vulnerability to poverty ratio
Total	51	100
Region		
Tigray	52	1.09
Amhara	50	0.7
Oromia	49	0.6
SNNP	52	0.8
PA		
Geblen	52	1.09
Dinki	51	0.8
Yetmen	50	0.7
Adele Keke	49	0.6
Gara Goro	52	0.8
Gender		
male	51	0.7
gfemale	51	0.7
Household size		
0-5	50	0.6
6-10	51	0.7
>10	52	0.8

Source: own calculation

4.6 Poverty Prevalence by Socio-Economic characteristics

Poverty incidence representing the share of the population whose income or consumption is below the poverty line or referred to us as the share of the population that cannot afford to buy a basic basket of goods can be quantified using some of socio-economic characteristics.

Poverty measurement indicators from table 8 show that the highest contribution to the proportion of poor households comes from the largest household size. As indicated in the regression

results from table 6 the results could be an indication to a sort of direct relationship between family size and vulnerability to poverty. Hence it deals with the notion of households that are considered poor tends to be bigger in in accordance with increase in the number of family members as it is explained in the definition of the variables in section 4.2.

Table 8: Poverty incidences by socioeconomic characteristics

Household Characterstics	Total number of poor	Percent
Household size		
1-4	162	25
5-8	176	52
9-12	37	59
Age		
21-40	80	39
41-60	174	47
>60	121	37
Number of livestock		
1-3	81	48
4-6	151	41
7-9	63	40
>9	81	37
Off-farm income in Birrs		
1-300	368	43
>300	8	37
Farm plot size in hectares		
0-0.5	236	45
0.6-2.0	68	47
2. 1-2.5	29	31
2.6-3.0	19	26
>3.0	24	17

Source: own calculation

As shown in table 8 an increase of the household size resulted in lesser prevalence or probability of a larger proportion of the poor to be vulnerable. Table 8 shows a household with less than four members is to be vulnerable to poverty compared with the households with family members above five. We could also learn from this pattern that household's security in terms of more consumption and a decline in the number of the poor supported from an increase in household size as indicated in the table. This can be justified on the fact that a larger proportion of the rural household is active and contribute to the farming activities and the household budget. Hence, the larger the family size, the lesser will be the incidence of poverty.

With regard to age, the highest proportion of poor households comes from those household heads that have the lowest age. An increase in experience (higher age) will improve earning capacities and thereby lowers poverty. Accordingly, a relationship between an increase in age and lower poverty as shown in the table 8 portrays an existence of a lesser proportion of the poor beyond the age of 59. The possible exception from the life cycle phenomena for those households with higher than or equal to 60 years can be explained in the notion of wealth accumulation. The increase of household size and age of the household age could be related in explaining the sudden shift in pattern of decreasing poverty level on the basis of such factors as the marriage of the daughters and independence of the bigger boys could deteriorate the size of the family and hence will have negative and positive impact to prevalence of poverty in the villages.

The highest contribution to the proportion of poor households comes from those households that have less livestock. A clear proportional pattern can be shown from the above table to a lesser contribution to poverty as the size of livestock increase from one to nine. The poverty level decreases for those household with one up to three livestock than for those households with a number of nine or more livestock. A possible reason to why the contribution to poverty is higher for households owning small number of livestock is the inadequate size that will decrease the coping capacity of the households to tackle poverty incidences. A trend in some villages of the ERHS shows the households face many shocks such as famine that will force the sale of their live stocks at cheaper price to provide food and other goods to their family. This made the situation to be very difficult to the households to maintain their livestock assets to cope up the future variations in consumption (Bevan and Pankhurst 1999). Hence, households that possess one to three livestock have less consumption behavior, not necessarily related with the size of cultivatable land ownership but a lost stock of domestic animals due to various shocks.

With regards to farm size, owning more than two hectares of farmland per household on average can be considered as a way out of poverty and hence less poverty prevalence compared to other households possessing less than two hectares. The highest proportion of poor households comes from those household that have none or very low amounts of farmland can also be related to the village topography and distribution of the sample location. Because the sample is taken from the agricultural zones of the country, the households of the sample have a significant dependence on farmland for their survival. Consequently, the preference of more

farmland and more livestock lead to a lesser contribution of poverty incidence. As indicated in table 8 households that possess a plot of farmland of 3 hectares or more are lesser in the proportion than others.

The proportion of the supplemental income from other activities such as poverty reduction strategic plan (PRSP) will definitely improve the poverty incidence of the households in the village. As shown in the above table households with more than monthly income of 300 ETB have very small portion of the poor compared to that of households whose other income is less than 300 ETB.

A result of the regression for the analysis of vulnerability to poverty is summarized in table 9. It shows that there is no association between poverty and vulnerability to poverty. The table and the figure below explicitly indicate the exact proportion of the poor and the non-poor category of the sample size is decomposed into vulnerable and non-vulnerable depending on their *ex ante* consumption behavior and variations in the future consumption. Accordingly 64% of the poor and the non-poor are vulnerable to the future poverty.

Table 9 Poverty and vulnerability (Percentage)

	Vulnerable	Non -Vulnerable	Total
Poor	80	20	100
Non-Poor	48	52	100
Total	51	49	100

Source: own calculation

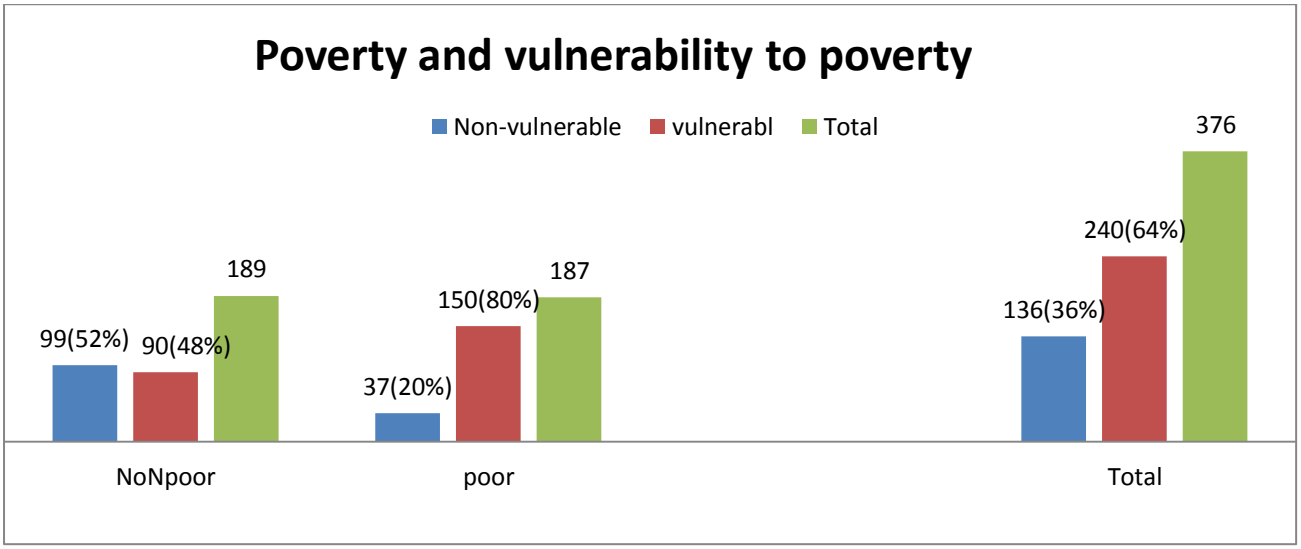

Figure3 Poverty and vulnerability to poverty

4.7 Regression Estimation of the Regions

The robust estimation of the results to the model for the logarithm of per capita the country consumption equation and variance of the logarithm of per capita consumption of the FGLS econometric method is presented in each of the region is shown in 11 below. The models (log of per capita consumption and variance of log per capita consumption) generally have most of its coefficients coming up with expected signs. Accordingly, emphasis is also made on the differences in either the level of significances of explanatory variables in the respective regions or reasons for complete insignificant level to others will be discussed in this section.

A separate econometric result in table 10 below depicts that in the three regions namely Tigray, Amhara and SNNP family size is significantly impact the logarithmic future consumption negatively for Tigray and SNNP but positively for Amhara region confirming larger household exerting more pressure on consumption than it contributes to production. It is mean to be more dependent household members in this region than the working force of the household members and hence impacting on the household poverty status.

In explaining welfare of the households in all the regions, average rainfall in millimeter negatively and uniformly affect welfare of the poor households at 1% level of significance indicating favorable rainfall to impact vulnerability to poverty of each household negatively.

The other important variable in the explaining welfare across the four villages is income received from off-farm activities. Accordingly off-farm income positively affects the future consumption at 5% level of significance for Tigray and Amhara regions but impact Oromia and SNNP regional states insignificant. Hence, the result can be an indication to be a representative most of the regions in Ethiopia where an income from the subsistent farming is supported by such sources. In contrary to northern regions to the former regional states which are favored by government to involve in activities for additional income for such reasons as frequent and unfavorable weather condition such as drought, inconsistent rainfall distribution, and very small arable land size and to each farming households, the Oromia and the SNNP regional states are found to be insignificant on this specific instance.

The consmpoor variable as poverty perception indicator significantly at 5% impact *ex ante* consumption in only Tigray villages as we can observe in table 10. This disintegrated econ-

ometric analysis of the regions prevail that the rest of the regions compared to Tigray region are in favor the poverty indicators in explaining vulnerability to poverty. In SNNP region amount of credit received from various sources is significantly impact the welfare of the households at 1%. This indicates the government policy to arrange credit to the households where formal financial institutions are absent, it is used to expend on necessary inputs such as improved seeds, agricultural tools etc…

The robust estimation of the results from the regression also shows that sickness of head of the household will negatively affect the welfare of the households of the Amhara region leading to a lesser variation in the future consumption. Time spent in fetching water and collecting wood also greatly affects the future consumption expenditure in almost all the households.

Therefore, the following tables is a supplementary econometric tool used to compare robust estimation of the results specified in table 6 that is employed to identify some of the important variables that determine vulnerability as expected poverty in a separate regions that constitute the total observation in the sample.

Table10: Model for the Estimation of Vulnerability to Poverty (FGLS)

	Tigray		Amhara		Oromia		SNNP	
VARIABLES	**Ln(cpcr)**	**Var(lncpc)**	**Ln(cpcr)**	**Var(lncpc)**	**Ln(cpcr)**	**Var(lncpcr)**	**Ln(cpcr)**	**Var(lncpcr)**
gender	**-0.04860**	**0.08765**	**0.00929**	**0.04406**	**-0.01344**	**-0.07260**	**0.28160**	**0.13467**
	(0.190)	**(0.123)**	**(0.116)**	**(0.069)**	**(0.145)**	**(0.071)**	**(0.169)**	**(0.120)**
hhsize	**-0.09764*** **	**0.00398**	**-0.11080*** **	**-0.00371**	**0.00613**	**0.00167**	**-0.18574*** **	**0.03029**
	(0.028)	**(0.012)**	**(0.017)**	**(0.009)**	**(0.027)**	**(0.012)**	**(0.033)**	**(0.020)**
age	**-0.01495**	**-0.00649**	**0.00317**	**0.00480**	**0.03378**	**0.00422**	**0.00563**	**0.02374**
	(0.059)	**(0.039)**	**(0.024)**	**(0.012)**	**(0.026)**	**(0.011)**	**(0.026)**	**(0.015)**
agesq	**0.00014**	**0.00003**	**-0.00001**	**-0.00007**	**-0.00030**	**-0.00003**	**-0.00003**	**-0.00022**
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
lstockv	**0.00003**	**-0.00001**	**0.00001*** **	**-0.00000**	**0.00002**	**-0.00000**	**0.00002**	**-0.00004***
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
cropa	**-0.18324**	**-0.44487**	**-0.04281**	**0.03311**	**0.79515**	**0.42974**	**-0.49294**	**1.72722**
	(4.303)	**(2.623)**	**(0.205)**	**(0.135)**	**(0.751)**	**(0.403)**	**(4.293)**	**(2.892)**
cropa2	**-0.00866**	**0.20873**	**0.01575**	**-0.00948**	**-0.21093**	**-0.12139**	**0.05993**	**-0.67584**
	(1.473)	**(0.878)**	**(0.036)**	**(0.023)**	**(0.208)**	**(0.097)**	**(1.592)**	**(1.045)**
infcommn	**0.25944**	**-0.11243**	**-0.04015**	**-0.00975**	**0.00944**	**0.02844**	**0.14602**	**-0.17429****
	(0.185)	**(0.122)**	**(0.062)**	**(0.032)**	**(0.085)**	**(0.041)**	**(0.105)**	**(0.066)**
schyr	**-0.03231**	**0.00979**	**-0.00788**	**0.00632**	**-0.03524**	**0.00837**	**-0.00772**	**-0.01793**
	(0.079)	**(0.041)**	**(0.024)**	**(0.015)**	**(0.046)**	**(0.030)**	**(0.024)**	**(0.015)**
timefwf	**0.00001**	**-0.00004*** **	**-0.00179**	**-0.00112***	**-0.00130**	**-0.00096**	**0.00007****	**-0.00005****

	(0.000)	(0.000)	(0.001)	(0.001)	(0.004)	(0.002)	(0.000)	(0.000)
sickdays	0.00334	-0.00276	-0.00318*	-0.00156**	-0.00315	-0.00049	-0.00172	0.00228
	(0.003)	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)
offarminc	0.00179**	-0.00034	0.00171**	0.00024	0.00122	0.00024	0.00098	0.00153
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
creditamt	0.00002	-0.00001	-0.00003	0.00007	0.00000	-0.00004*	0.00023***	0.00002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
tramt	0.00019	0.00015	0.00008	0.00012				
	(0.000)	(0.000)	(0.000)	(0.000)				
mrainmm	-0.00210***	-0.0001	-0.00160***	-0.00009	-0.00350***	-0.00001	-0.00600***	-0.00010
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
consmpoor	-0.41001**	0.35174***	-0.14538	-0.08367	0.00682	-0.34645***	-0.24955	-0.24586*
	(0.164)	(0.111)	(0.139)	(0.073)	(0.297)	(0.091)	(0.175)	(0.130)
Constant	5.17259	0.67099	8.09624***	0.16412	4.56380***	0.10799	5.39379*	-1.51948
	(3.974)	(2.660)	(0.640)	(0.347)	(0.869)	(0.394)	(2.916)	(2.017)
Prob(F)	0.000	0.021	0.000	0.422	0.671	0.017	0.000	0.024
Observation	65		130		89		92	
R-squared	0.41	0.35	0.57	0.15	0.15	0.155	0.432	0.212

Source: Author's Computation

Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Note: lncpcr = Log of Real Consumption per capita per household, Var(cpcr) = Variance of Consumption-statistics are in parenthesis

5. Discussion of Econometric Results

Table 7 shows that 51% of the Ethiopian population near the selected sample region was vulnerable to poverty. This is significantly higher than the observed poverty level of about 38.7 % national average[4]. Rural households have higher average vulnerability to poverty than urban households (MoFED 2008). A similar situation is reported on current poverty within rural households as indicated in table 8. Furthermore, the findings support the evidence that poverty and vulnerability to poverty may not necessarily be interchangeably treated or interpreted as such.

Again, vulnerability to poverty is found to be different almost among different households. According to table 7 the proportion of the households is 52%, 50%, 49% and 52% for Tigray, Amhara, Oromia and SNNP regional states respectively. The results further confirm that vulnerability estimate of the villages from Amhara and Oromia showing a good welfare status compared with the two other regions. This can justified from the point of view of additional income generating activities, such as sale of homemade beverages, income received from sale of vegetables and PRSP program support from government to smooth consumption.

Emphasis can also be given from the reports that the role of female headed households to be higher in the SNNP and Tigray regions compared to the two regions. This may lead to a higher contribution of vulnerability to poverty due to a shortage of time spent on land preparation, cultivation and weeding in addition to their home responsibilities or burden that will exacerbate the household poverty some periods in the future. Hence, policies directed only towards observed poverty favoring the female headed households are not enough if poverty is to be reduced in the long term.

Therefore, poverty reduction programs that focus only on the current poor households within the given regions neglecting currently not poor but are likely to be poor in the future at the time of execution of the program are worthless to adequately reduce future vulnerability to poverty.

[4] 'Rural poverty and vulnerability are pervasive throughout the country; with an estimated 38.7% of the rural population living below the nationally defined poverty line compared with 38.7% national average'

We can also observe from the results that household health status being a significant factor that determines vulnerability to poverty. It can be explained in terms of the expected average consumption to positively affect the number of sick household heads. This implies the decline in the general household health status determining the pattern of future consumption. Hence, the poor health status of each household is expected to reduce the welfare households and raise the risk of vulnerability to poverty in the near future. From the vulnerability analysis we can suggest that designing policy interventions instruments to better perform on simple access to health institutions as a key measure to improve welfare of the households.

The findings confirm that off-farm income is a better source of income that will enables individuals to engage in productive activities that translate positively into their consumption and investment activities. Moreover, this finding provides empirical evidence with higher or at least positive impact on the welfare of the household in all the estimation.

In Ethiopia the availability of land (i.e. plot of land per household is diminishing) to the rural household is inadequate and crop production is very low to smoothen consumption. And hence interventions that can exacerbate vulnerability to poverty and benefits from achievement of alleviation of future poverty must not only relate to the Millennium Development Goals but also must aim in translating poverty into improved current and future welfare reduction of the future poverty. Since poverty is deeper in rural areas of the regions, agro-climatic conditions, highly limited market access, poor infrastructure, remoteness, land degradation and a lack of formal insurance mechanisms are some of the main factors that contribute to conditions of the households to be susceptible to shocks otherwise (Dercon et. al., 2007). As a result, farmers tend to be risk averse and less likely to adopt new technologies that will further undermine productivity and growth (World Bank 2006). In this analysis, similar situation is prevailing, thus supporting the above scholars' view indicating a negative relationship between average consumption level of a given household and their probability of falling into poverty sometimes in the future.

While average future consumption is estimated to be low among larger households, variations in future consumption is estimated to be lower for households with larger members. This pattern is well reflected by the statistically significant and negative sign of the estimated coefficient associate with the variable "hhsize" (see Table 6). The insignificance of the household size could be explained by the cross-sectional nature of the data set and thus could not capture

the intertemporal variability of consumption in each household.

On the other hand the negative variation in *ex ante* logarithmic consumption may have occurred for reasons that large households tend to have larger labor force since child-age that may be used as a source of labor in times of difficulty. Moreover, households with more members usually have better social networks such as *'debo'*[5] as each member of the household engage in cooperative production activities with others in the community that will increase their credit to other households to involve in the harvesting according to their turn. (Makoka, 2008). However, the impact on expected mean consumption is remaining significant compared to the impact on expected variance of consumption.

The level of educational attainment measured by a number of school years insignificantly relates to vulnerability to poverty. This is may be for the same reasons explained in the previous paragraph, attrition problem or poorness of the data set in defining causality of events. But the sign the variable positively relates to both expected mean and variance of consumption which would be an indication for possibilities of welfare improvement of each household arising from succession from going up the ladder of educational levels even in the primary level. In other words, households headed by educated heads are less vulnerable to poverty compared to those households headed by lower level of educational attainment. Ligon and Schechter (2003) in their study have find out that college educated heads on average are 16% less vulnerable than households with uneducated heads.

In conclusion, some of the findings obtained from the model in table 6 are also reflected in the regional regression result reflected in table 10. The selected variables to measure vulnerability to poverty are most likely appropriate to determine the welfare status of the selected rural villages within the given region in Ethiopia. While most of the variables insignificantly impact logarithmic consumption and variation in the consumption behavior of each household, the coefficients attached to each variable are as expected. Regardless of the constraints on the methods used in the thesis and the limited number of observation used from the ERHS survey data the findings in this thesis are good indicators that may require extensive research.

[5] *'Debo'* is one of traditional insurance institutions in rural Ethiopia that is used to combat seasonal harvest fail due luck high technology. It is a mechanism in which each household will contribute labor force to each other mostly during weeding and cultivation season.

6. Conclusions and Policy Recommendation

This thesis has made an effort to investigate vulnerability to poverty in Ethiopia using a single cross section data from ERHS. Vulnerability is defined as the *ex-ante* risk of being poor next year ahead. Estimation of probability of expected poverty from such data set requires an estimate of the distribution consumption for households, setting a threshold level below which the household is considered poor and the probability at or above which a household is considered vulnerable (Chaudhuri et al. 2003). In light of the evidences revealed in this study the following conclusions and recommendations are drawn.

The problem of poverty is pervasive in Ethiopia in general and particularly in the four selected regions. The analysis from the data set indicates that among the 376 sampled households in the rural villages of Ethiopia 187 (49%) households are found to be poor while 189 (51%) of the households were non-poor. Thus 49% of the sampled households could not get the minimum recommended calorie level (2200 Kcak/adult per day) from incomes generated by agricultural activities.

Accordingly, the findings from this study suggest that vulnerability to poverty arise as a result of community level characteristics, and household characteristics. As a result, while 51% of the Ethiopian population is poor, of which the majority of these (80%) are vulnerable to poverty and 52% of the non-poor will be expected to slip into poverty at least one period ahead (47% of the population). The findings further suggest that more than two-thirds of the population is vulnerable to poverty in the future. The results from the study also show that vulnerability is dominated by low expected mean consumption vulnerability accounting for about 90% of the total vulnerability (or 75% of the total population) and only a few are accounting for low volatility of the future consumption.

In terms of geographical location, due to high concentration of population per hectare of a plot of land vulnerability to poverty in the selected villages is the most probable incidence throughout the country. It can be concluded from the results that those residing in the southern rural region are the most vulnerable to poverty compared to those living in the Northern and central rural regions.

It is also demonstrated in the study that household size is one of the determining factors of vulnerability to poverty in Ethiopia. Hence, this study found out that vulnerability to poverty

tends to decrease significantly with the increase in the family size as shown in the negative relationship.

Findings from estimated regression analysis also suggest that off-farm income to be one of significant variables that indicates other incomes received from non-agricultural activities to negatively affect the probability of households to be poor.

Whereas other variables such as: the health status of the household heads, access to information technologies and most of the variable in determining welfare status of rural households are statistically insignificant. This confirms that better study that may the quality of the requirements in the estimates of a stochastic consumption process, use of larger number of observation and hence related strong assumption that go from consumption process estimate to vulnerability estimate.

Therefore, an extensive and strong research is recommended to be done to better understand rural poverty in connection with vulnerability, livelihood strategies and gender issues to improve the welfare of rural households and accelerate technology adoption. The research can be extended to include poverty mapping, value chain and market analysis, and policy and institutional options in agricultural and non-agricultural production activities that may lessen the variations in consumption level.

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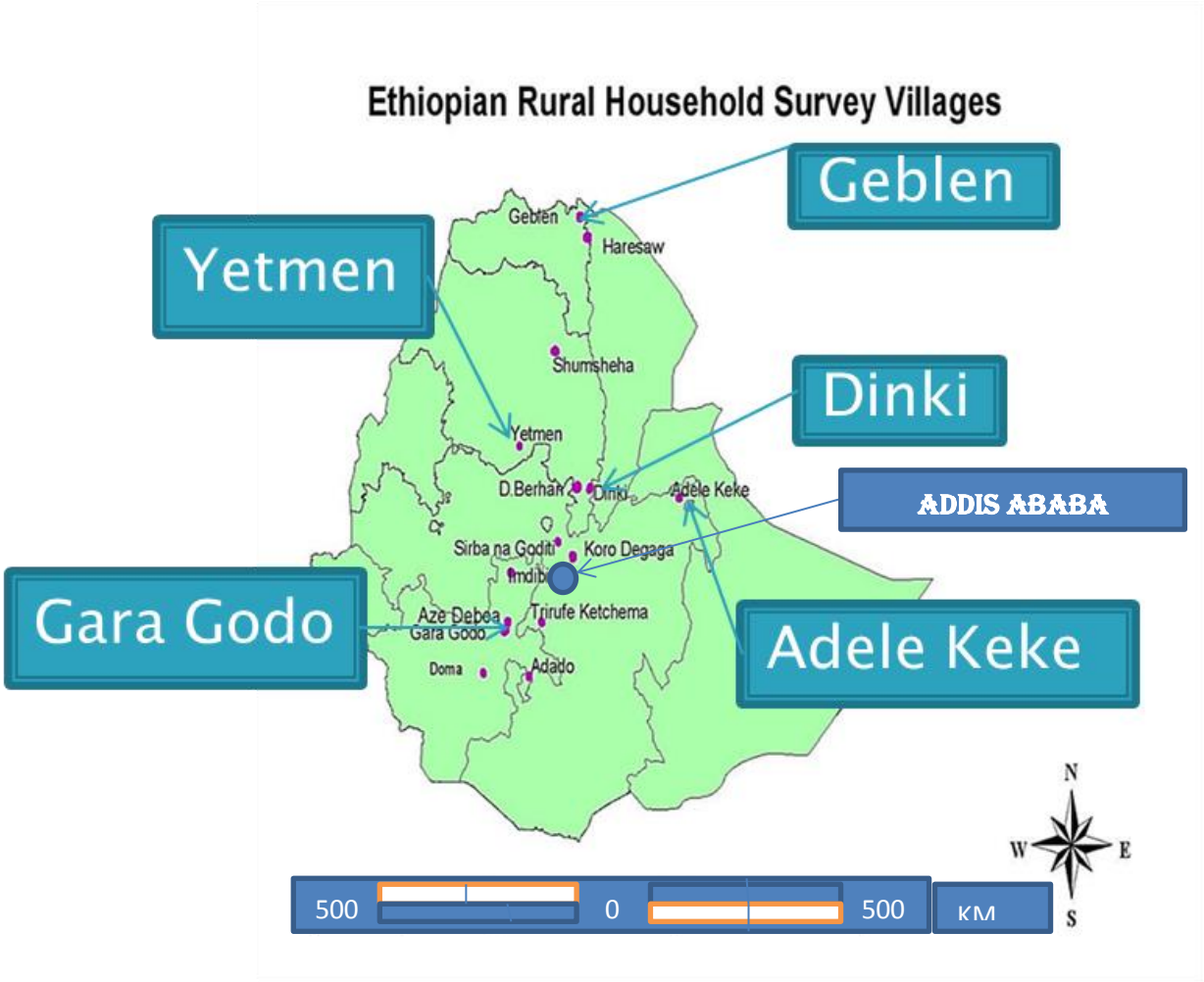
Appendices

Appendix 1: Map of Ethiopia and the Survey Villages



Appendix 2: Summary of the study villages

The following summary is an extract from Ethiopian villages studies (1996) attached in the ERHS data base.

Geblen (65 households)

Geblen is located in Eastern Zonal administration of Tigray with its capital at *Adigrat*. *Subha-saesie* is one of the 15 *Woredas* that make up the Eastern Zonal administration of Tigray. The *Woreda* comprises an estimated population of about 102 thousand in 1993. The nearest towns are the capital of the *Woreda Edagahamus* (about 20km from the site depending where in Geblen one starts) and Adigrat (18km). *Edagahamus* is named after the former market day; "*Edaga*" means "market" and "*Hamus*" means "Thursday" and it means "Thursday Market". *Edagahamus* is situated 878 kilometres north of Addis Ababa on the main Addis Ababa-Asmara road. Geblen consists of four *kushet* namely *Welae-labur* (with 6 sub-units), *Ereta* (8 units), *Kaslien* (7 units), and *Semuydaga* (9 units). These four *kushet* are fairly large and are quite apart from each other, but are served by a single church, namely *Inda Michael Geblen* (Saint Michael's Church of Geblen). One report says that Geblen has a population of 2,637 in 675 households; another that the total population is 2216 (1048 males and 1168 females) in 853 households, and another that it was 2,437 in 1993. Most households have access to about ¼ hectare of land. About 30 people are landless. Almost all households are registered with the PA. There are a few non-registered and landless households who are mostly ex-soldiers, ex-fighters, displaced people and refugees who returned after the 1990 land allocation. Geblen is the smallest village in the area. Geblen is at an altitude of approximately 2700m and can be classified as a predominantly *woyna dega (semi-arid)* area, although two *kushet* (Kaslen and Erata) fall under the *kola(arid)* classification.

Dinki (79 households)

Dinki is situated in North Shewa near Ankober. Ankober is one of the administrative *woredas* found in the Administrative Zone of North Shewa which covers most of north-eastern Shewa. The total population of north-eastern Shewa was estimated at 1.4 million after the 1987 Census. Crude population densities are estimated to be high in the Western districts (80-100 per square kilometer) and low in eastern districts (about 10 per square kilometer in *Dulacha* and 30-50 in *Yifat, Bure Medayta* and *Efrata* and *Jile* districts).

Dinki is among the 86 PAs administered by *Ankober woreda*. It is 43 kms from Debre Berhan (the administrative seat of the zone) and about 2 hours walk (8km) from *Alyu Amba* - a very small town 17 kilometer from Ankober.

According to one informant, there are 138 households in Dinki's peasant association and 643 people living in the village, of which 296 men and 337 women. Another said there are 125 households, 27 of which are headed by women. Twelve of these women pay taxes. At the 1995 *woreda* level election in the PA the number of people eligible to vote was 302: 152 men and 150 women. Given the total number this would suggest that children below 18 constitute about half of the population. One informant said there are 57 households not registered with the PA and 23 households which are landless. The other informant said there are 30 male headed and 15 women-headed households which are landless. There are five villages surrounding the area: *Aygebir, Addis Alem, Chibiteina Gendamiha, Lalo,* and *Merereina* in descending order of size. *Aliyu Amba* is the nearest town and is 8-10 kms away. There *is no* government organization in the town; it is a suburb to the capital of the *woreda* which is 24 km from the village.

In terms of land size Dinki is smaller than neighboring PAs. The altitude near Dinki river is 1400m and this increases as one goes up in the PA. The zone is *kolla* (lowland) and the site is hilly; the river Dinki runs down the gorges of the village. Dinki's PA is relatively poorer than neighboring PAs.

Yemen (51 households)

Yetmen Peasant Association and Yetmen *kebele* (a small town on the territory of the larger Yetmen PA) are situated at the southern end of *Enemay Woreda* in East Gojjam Zone, an administrative unit in what has recently become *Killil* (region) three.

Yetmen is treated as an urban center in the 1984 Housing and Population Census. This is because of the definition of the census that stated "all administrative capitals and localities in which urban dwellers' associations were established were considered as urban centres, irrespective of the population size" (1990:2). As a result, Yetmen is located about 248 kilometers North-West of Addis Ababa between the towns of Dejen and Bichena. Dejen is 17 kms south of the PA and Bichena is 15 kms north of Yetmen.

Yetmen is situated in an area suitable for agriculture. There are two rivers surrounding the PA. *Muga* is all time weather while *Yegudfin* exists only in the wet season. The 1984 Housing

and Population Census estimated the total population of Gojjam to be 3,273,524 with the majority (92.1 %) living in rural areas (1990: 2 and 29). The total population of Bichena town was estimated to be 7,951 while the population of Yetmen town was estimated to be 562, of which 226 are male and 336 female.

Adele keke (89 households)

Adele keke is a PA located in the eastern Oromia region. It is adjacent to Dire Dawa and Harar motorway. It is almost 2000 meters above sea level on the great plateau of Harar. The PA association is very close to the seasonal lake *Adele* which only flows from July until September.

Adel keke is a very large PA which consists of 28 villages. Distance between villages is less than four kilometers. Mountains and hills are eroded by heavy rain filling the lowland and the valley with soil. The highest places have infertile soil converting the area into desert. Total population of the PA is estimated to be more than 4500, of which 1300 are female headed.

Gara Godo (92 households)

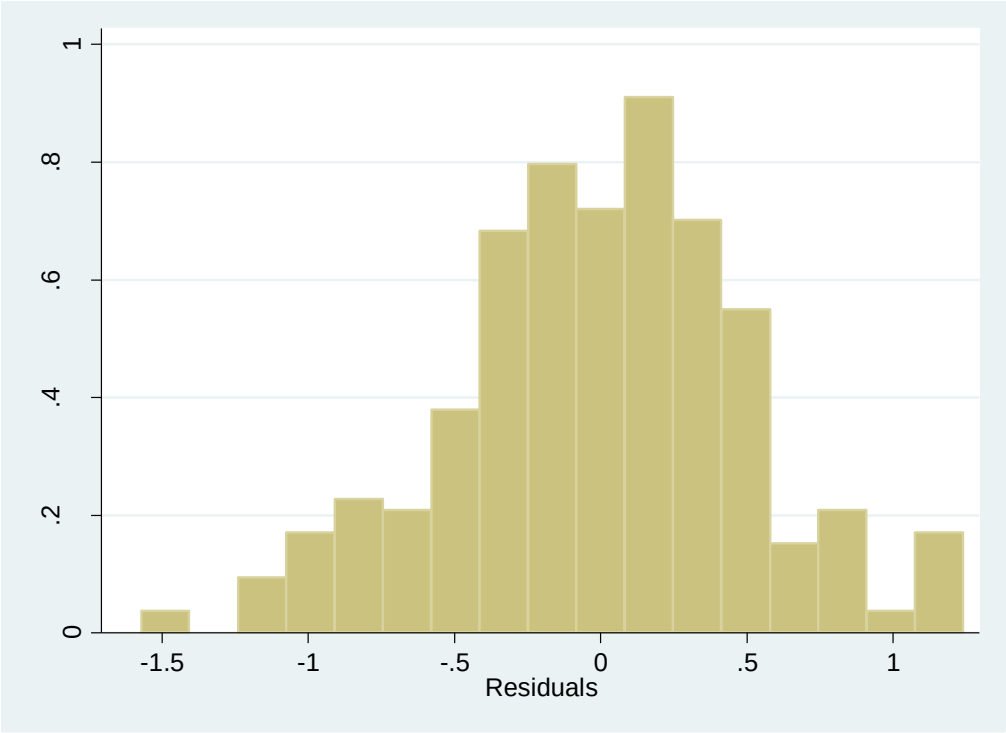
Gara Godo is one of 43 Peasant Associations (PAs) located in Bolosso *Woreda*. *Gara* means wild pig and *godo* means chasing for hunting. Long ago the residents hunted and killed wild pigs which troubled the area. According to the current demarcation, Wolayitta belongs to the North Omo zone of the Southern Ethiopia administrative region. Wolayitta is perhaps, the most densely populated region of the country.

It is estimated that there are between approximately 1750 households at the site with an average household size of seven. About 420 of these households are female-headed. Gara Godo PA is larger than the surrounding PAs in the *woreda*. It contains four zones namely Hago zone, Godo zone, Tokisa zone and Chala zone. Pressure on land and population density and consequent agricultural practices, and complex traditional institutions make Wolayitta unique in the country. The PA is full of huts which can accommodate at least six household members.

The peasant association is very densely populated and a household might own as little as ½ *timad* (measure of plot of land equivalent to 1 ha*)* of land, some having only a garden. The nearest town is Areka which is 11 km east of Gara Godo. The general quality of land is *lem (*Very fertile*)* with brown colored soil. The population is made up almost exclusively of Wolayitta and is culturally homogenous although religious and clan distinctions exist; it

sometimes plays a part in the life of the community. Gara Godo is at 1,730m above sea-level and is classified as *woyna dega (*semi-arid*)*.

Appendix 3: Graphical representation of the estimated residuals



Plot of log real consumption per capita over the fitted values

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