Ethiopian Economics Association
(EEA)

PROCEEDINGS OF THE EIGHTH INTERNATIONAL CONFERENCE ON THE ETHIOPIAN ECONOMY

Edited by:
Getnet Alemu
Worku Gebeyehu

Volume I

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- ALL ACTIVITIES OF EEA ARE SPONSORED BY THE AFRICAN CAPACITY BUILDING FOUNDATION (ACBF), EMBASSY OF UK (DFID), EMBASSY OF SWEDEN (SIDA), THE NORWEGIAN CHURCH AID, EMBASSY OF NETHERLANDS, EMBASSY OF IRELAND (DCI), FRIEDRICH EBERT STIFTUNG OF GERMANY (FES), AND INTERNATIONAL DEVELOPMENT RESEARCH CENTER (IDRC) OF CANADA.

- THE 8th INTERNATIONAL CONFERENCE WAS CO-ORGANIZED BY THE ETHIOPIAN STRATEGIC SUPPORT PROGRAM II (ESSP II) OF THE INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE (IFPRI).

FOREWORD

The Ethiopian Economics Association (EEA) is happy to issue three volumes of the proceedings of the 8th International Conference (the 19th Annual Conference) on the Ethiopian Economy that was held from June 24 – 26, 2010 at EEA Multi-purpose Building Conference Hall. EEA has been organizing annual conferences on the Ethiopian Economy every year as part of its overall objectives that include contributing to the economic policy formulation capability; promoting the professional development of its members; promoting the study of Economics in the country's educational institutions, promoting economic research and disseminating the findings of such researches in the country, providing fora for the discussion of economic issues and promoting professional contacts between the Ethiopian Economists and those of others.

In its effort to achieve its objectives, EEA has over the last two decade expanded from a handful of members to over 3000 members; from just a Secretariat to an additional institute called Ethiopian Economic Policy Research Institute (EEPRI) established in 2000 as a research and training arm of the Association; from an asset of a few hundred Birr to the owner of Multi-purpose Building; from a newsletter to publication of various products which include Economic Focus, Quarterly Macro-economic Report, Annual Economic Report, Bi-annual Ethiopian Journal of Economics, Proceedings of the Conferences etc.; from a simple roundtable discussion to the regional and International conferences and many thematic discussion forums. These have earned EEA respect from the development community including policy makers, business communities, civil society organizations, donors and the public at large and become a truly independent source of socio-economic policy options and data base in Ethiopia.

The 8th International Conference on the Ethiopian Economy attracted high turnout of the participants, papers presenters and session organizing institutions. The conference was attended by about 470, 300 and 250 participants during the first, second and third days of the conference, respectively. The conference officially opened by H.E. Ato Sufian Ahmed, Minister, Ministry of Finance and Economic Development.

At the conference about 85 papers were presented in three plenary and five breakout sessions. Out of the total 85 papers, about 39 papers were presented by partner institutions like IFPRI-ESSP II, ILRI, FSS, Young Live Ethiopia, National Social Protection Platform led by UNCIF and WB. The rest 46 papers were presented by individual researchers. The editorial committee reviewed papers that were presented for the publication of the proceedings of the conference and communicated its comments and suggestions including editorial comments to authors. After passing all these process and language editing, the editorial committed selected 31 papers to be included. All these papers are organized into three volumes. Volume I contains Poverty and Social Sector, Volume II contains Business Environment, Population and Urbanization and Volume III contains Agriculture and Related Activities.

I would like to take this opportunity to express my heartfelt gratitude, on my own behalf and on behalf of the Ethiopian Economics Association to the co-organizer of the conference, the **Ethiopian Strategic Support Program II (ESSP II) of the International Food Policy Research Institute (IFPRI).** ESSP is a unique collaborative effort between IFPRI and the Ethiopian Development Research Institute (EDRI). The program, which is based in Addis Ababa, begin its activities in late 2004 with the aim of undertaking timely and actionable research to fill knowledge gaps in the formation and implementation of economic policies, improving the knowledge base available for such analysis, and strengthening national capacity to undertake such work.

I would like also to thank the authors of the papers and the audience whose active participations made the conference meaningful and dynamic. The many professionals who dedicated their time to the conference and served as chairpersons deserve due thanks for their special contributions.

The staffs of the EEA deserve a special recognition for their enthusiasm and perseverance in managing the conference from inception to completion. I also want to extend my personal gratitude to the Organizing Committee and members of the Executive Committee of the Ethiopian Economics Association for the dedicated services and the leadership they provided to the Association.

Our special thanks go to our partners who have shared our vision and provided us with generous financial support to materialize the activities of EEA. These include; The African Capacity Building Foundation (ACBF), The Norwegian Church Aid, The Royal Netherlands Embassy, The Swedish Embassy through SIDA, The Development Cooperation of Ireland (DCI) and the Ireland Embassy, the British Embassy through DFID, the Friedrich Ebert Stiftung of Germany, and International Development Research Center (IDRC) of Canada.

Finally, I would like to extend my sincere gratitude to H.E, Ato Sufian Ahmed, Minister, Ministry of Finance and Economic Development, for his an insightful keynote address; and other senior government officials who spared their busy schedule and participated in the conference.

Alemayehu Seyoum Taffesse (Phil.D)
President of the Ethiopian Economics Association

TABLE OF CONTENTS

Volume I
Poverty and Social Sector

Poverty and Social Sector

DETERMINANTS OF HOUSEHOLD POVERTY: THE CASE OF GONDAR CITY IN ETHIOPIA

Getachew Jenber[1]

Abstract

Ethiopia is known all over the world for its chronic condition of poverty. As a result the Ethiopian government, multilateral agencies and other stakeholders consider poverty as their priority agenda. This study deals with the determinants of urban poverty with the objective of identifying the poverty status of households and the main factors that push them to the poverty trap. The data for the study came mainly from cross-sectional survey of Gondar city in 2009. Samples of 240 household heads were selected by a systematic random sampling method. Food Energy Intake (FEI) method and Cost of Basic Needs (CBN) approach are utilized to calculate food poverty line and total poverty line respectively. The internationally accepted $1 a day poverty line was also employed for comparison purpose. Logit model was employed to identify the determinants of poverty. Probabilities of household being poor as dependent variable and a set of demographic and socio-economic variables were employed as explanatory variables. The study found that head count ratio of poverty, poverty gap and poverty severity indices are 0.329, 0.0704, and 0.0225 respectively. Income, family size, remittance, educational level, housing ownership, health status of the households, marital status and employment type have statistically significant impact on the incidence of poverty, whereas sex, proportion of female, parent of household head education, access to basic services, age, and dependency ratio were found to be insignificant. It was also found that poverty incidence widely varies among the different kebele administrative areas in the city. Thus, stakeholders, working on poverty should mobilize their resources and efforts to tackle poverty taking into account the nature and severity of the underlying factors and intervention areas.

Key words: Poverty, Household, Logit Model, Gondar, Ethiopia.

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1. Introduction

Poverty still affects a high proportion of the world population. Chen and Ravallion (2008) updated the previous studies of population living below poverty line. In their study, the population living below poverty line is estimated to be 1.4 billion, or one quarter of the population of the developing world. Although a lot of efforts are exerted in poverty alleviation strategies, the result obtained has been uneven across regions. According to the findings of the same authors, the poverty rate in East Asia fell from almost 80% to under 20% over the period 1981 to 2005 but remained around 50 % in Sub-Saharan Africa (SSA) despite some signs of progress since the mid 1990s. The share of the world's poor living in Africa has risen from 11% in 1981 to 28% in 2005 (Ibid, 2008).

Therefore, poverty is a chronic problem for the developing world in general and for Sub-Sahara Africa in particular. Ethiopia is amongst the world's poorest countries, having a rank of 171st out of 182 countries in terms of human development index (HDI), with human poverty index (HPI) of 130th out of 135 countries for which the index was calculated (UNDP, 2009).

In the past successive years the government of Ethiopia has formulated and implemented poverty reduction strategies and programs. Assessment of these efforts shows a notable drop in the incidence of rural poverty from 45 percent to 39 percent and the Gini coefficient, which shows the inequality at the national level has been stable at around 0.30 (MoFED, 2006). The urban poverty showed only a marginal decline in the proportion of the poor from 37 percent in 1999/00 to 35 percent in 2004/05. Nevertheless, the poverty condition would worsen if 1996/97 is taken as a base year, during which poverty head count ratio was 33% (MoFED, 2007).

Even though the government of Ethiopia has tried to address poverty-related problems, the efforts have not been sufficient in proportion to the extent of the problem (Tesfaye, 2006). The living condition becomes more severe than before with increase in income inequality from 0.38 in 1999/00 to 0.44 in 2004/05 within the urban population (MoFED, 2007). Previous poverty studies in Ethiopia have greatly focused on rural than urban areas as due consideration was given for the 85 % of the population living in rural areas (Tesfaye, 2006). The few studies available (Bigsten et al 2005, Degefa, 2008) mainly focus on regional centers like Mekele, Bahir Dar, Awassa, Nazareth and the primate city Addis Ababa. To the knowledge of the author, there has not been any study on the condition and determinants of poverty in Gondar despite the prevalence of widespread poverty incidence in the city. Hence, this research focuses on determinants of household poverty in Gondar city and the findings are deemed important for other similar cities and urban areas. The general objective of the study is to identify the determinants of poverty and poverty conditions of the study area. The Specific objectives are to determine poverty line, poverty indices and identify determinants of poverty.

The study is significant to guide appropriately future policy development and poverty alleviation interventions. Moreover, it is important for monitoring and evaluation to be a benchmark to measure the progress of interventions in reducing poverty in the city.

The scope of the study is delineated to mainly on urban household demographic and socio economic characteristic. Some variables that are considered in literature to characterize community and regional poverty situations are excluded. For instance, remoteness; quality of governance including crime and violence, property rights and their enforcement, etc are not treated in this study.

2. Study area

Gondar city was established in 1632 G.C. by Emperor Fasiledus (Habtie, 2000). It was the capital city of Ethiopia for more than 200 years. As a result the emperors of Gondar left behind their legacy, which makes Gondar rich in ancient palaces and castles. At present, Gondar is the center of North Gondar administrative zone and has a metropolitan city administration status.

Gondar is located 748 kms far from the present capital of Ethiopia, Addis Ababa. It is currently one of the well known tourist attraction sites of the country. Geographically, it is located $12^{0}40'$ North latitude and $37^{0}45'$ East longitude. The city has an estimated area of 5560 hectares. Its elevation ranges between 2000 – 2200 meters above sea level. The mean annual temperature of the city is $20^{0}C$ and it receives an annual rainfall of 1172 mm. According to CSA (2007) Gondar has a population of 206,987of which 47.4% are males and 52.6% females, excluding the population of the rural kebeles[2]. Orthodox Christianity dominates the city and accounts for 83.3 % of the total population followed by Muslims 15 % and the remaining 1.7 % other religions.

According to the city administration office, the main economic activities of Gondar city are service provision, manufacturing, agro-processing, urban agriculture and tourism. As a result of its geographic advantage and endowed resources, Gondar is still a very important site of the country. The western districts of North Gondar are the main producers of cash crops like sesame and spices; the central districts produce the main staple food of the country, "teff[3]" and maize, and the northern districts which are

2 It is the lowest Administrative level in Ethiopia.
3 Name of crop, which is staple food for many parts of Ethiopia

cereal producers also use Gondar as their market center. In spite of these golden opportunities, a significant part of the population is affected by poverty and it is not uncommon to see tearful eyes and begging hands in the slums of the city.

3. Literature review

3.1. Conceptual framework

Poverty refers to lack of physical necessities, assets and income. It includes, but is more than being income-poor. Poverty can be distinguished from other dimensions of deprivation such as physical weakness, isolation, vulnerability and powerlessness with which it interacts (Robert Chambers, 1995).

Jayati Ghosh (1998) defines poverty as follows. Using income criterion, a person is considered as poor if his/her income (or expenditure) is below a defined poverty line. Usually this is in terms of per capita household income or expenditure, for which data are more readily available. In the basic needs criterion, poverty is viewed as deprivation in terms of various material requirements including, but not only, food. This approach incorporates other basic needs, such as access to basic health and education services, minimally adequate and safe housing, access to safe drinking water and sanitation. The capability criterion relates to simple functions, such as being adequately nourished and clothed, and to more complex capabilities, such as being able to participate effectively in the social life of a community. This approach thus incorporates the problem of social exclusion or marginalization in the idea of poverty, and is, therefore, much broader than even the basic needs perspective.

Poverty Line

Poverty line is cut-off living standard level below which a person is classified as poor (World Bank 1993). In setting poverty line three approaches such as absolute, relative or subjective approaches can be followed. According to Revallion (1992) an absolute poverty line is one that is fixed in terms of the living standard indicator being used and fixed over the entire domain. Relative poverty refers to the position of an individual or household compared with the average income in the country, such as a poverty line set at one-half of the mean income. Subjective poverty approach clearly recognizes that poverty lines are inherently subjective judgments people make about what constitutes a socially acceptable minimum standard of living in their own societies.

According to Kakwani (2003) in developing economy absolute poverty line is a best fit of all others. It is because the relative approach which defines the poverty line in relation to the average standard of living enjoyed by a society and thus relatively poor people could exist in this context even in a developed world regardless of high level of income. There are different methods in setting absolute poverty line, among which Greer and Thorbecke's (1986) Food Energy Intake method (FEI) and Rowntree's (1901) Cost of Basic needs (CBN) are the most practical and frequently used as measure of absolute poverty line (Muhamed, 2008).

Food Energy Intake method defines the poverty line as the consumption expenditures or income level at which a person's typical food energy intake is just sufficient to meet a predetermined food energy requirement. As Kakwani (2003) cited, Greer and Thorbecke (1986) propose a method of computing the food poverty line at which a person's food energy intake is just sufficient to satisfy a given required quantity of his or her daily calories.

In the Cost of Basic Needs Method, poverty line is set by taking the sum of food and non-food costs of basic consumption basket. The first step in the construction of a food poverty line is to determine the calorie requirements of people of different age and sex. These calorie requirements are generally available from nutritional authorities. The next step is to find the food basket and its value that would meet these requirements. There can be several food baskets that meet individuals' nutritional needs. However, for the food basket to be realistic it should reflect the consumption pattern of the population (Ibid, 2003).

The most popular and earliest measure of poverty is the Head Count Ratio (p_0) which is simply the ratio of the number the poor, *q*, who are defined in a certain way, to the total population in a community, *n*. In other words, head count index is the proportion of the population whose measured standard of living (consumption) is less than the poverty line.

The other two common measures are poverty gap and severity gap. Poverty gap index (p1) is the difference between the poverty line and the mean income of the poor expressed as a ratio of the poverty line. It is sometimes called the income gap ratio. This measure gives a good indication of the depth of poverty, but it does not capture the severity of poverty. For example, measure of poverty will be unaffected by a transfer from a poor person to someone who is very poor. The measure is not sensitive to the distribution among the poor (World Bank, 1993). Poverty gap means the total income shortfall to eradicate poverty.

Severity Gap (p2) is a measure of the severity of poverty which is additive in the Foster-Greer-Thorbecke p_2 measure (Ravallion and Bidani, 1994). It is defined as the mean of the squared proportionate poverty gaps. The mean is formed by the entire population, taking the non-poor counted as having a zero poverty gap. This measure reflects the severity of poverty in that it is sensitive to inequality among the poor.

3.2 Empirical evidences

Scholars identified many determinants or correlates of poverty. The majority of the findings are similar except for some local differences. Using a logistic regression model, Garza (2001) finds the size of the household, living in a rural area, working in a rural occupation and being a domestic worker to be positively correlated with the probability of being poor in the case of México. Education, age of the household head, working in a professional occupation and working in a middle level occupation are negative correlates of the probability of being poor. However, no evidence is found to support the hypothesis of a high link between female and poverty.

A study on determinants of urban household poverty in Malaysia with the use of a binomial logistic regression model finds low education attainment and higher proportion of children less than 15 years of age in the household to increase the probability of a household falling into poverty [Mok *et al,* 2007].

Employing a Logit model, Alemayehu *et al* (2005) finds a strong association between poverty and the level of education, household size and engagement in agricultural activity, both in rural and urban areas of Kenya. Female-headed households are found to have a more likelihood of being poor than men and that female education plays a key role in reducing poverty.

had identified the Based on the 2003 Household Income and Expenditure Survey Fagernäs and Wallace (2007) find low levels of education, and especially of female education, are associated with higher levels of poverty in the case of Sierra Leone. Households with more children are worse-off in Freetown (urban), but better-off in rural areas. Female-headed households are also better-off in rural areas, and worse-off in Freetown. However, household welfare rises with the share of women in the household.

Kedir and McKay (2003) employ a panel data set of 1500 households drawn from the Ethiopian Urban Household Surveys from 1994 to 1997. Both the descriptive and econometric evidences indicate that chronic poverty is associated with household composition, unemployment, lack of asset ownership, casual employment, lack of education, ethnicity, and age to a certain extent with female-headedness.

Tesfaye (2006) also conducted a study on urban poverty in Ethiopia using two rounds of the Ethiopian Urban Household Survey. In his finding he reveals that urban poverty is widespread in the country and identifies socio-economic and demographic factors affecting poverty. Households consisting of casual workers, female heads engaged in household business activities and households with large family size are found to be relatively poor. On the other hand, households headed by college or university education experience less incidence of poverty.

Esubalew (2006) assesses the determinants of urban poverty in Debremarkos town using Cost of Basic Needs (CBN) approach to identify the poor from non-poor and Logistic regression model to identify the determinants of poverty. The study find that sex, household size, and health status of the household are positively correlated with the probability of being poor, whereas, income, educational level, marital status, employment, age, housing tenure, water source, electricity connection and telephone service are negatively correlated.

The empirical evidence explained above indicates that the determinant or correlates of poverty in many areas are similar but some socio-economic factors show different effect based on specific conditions of the study area. No study is undertaken in Gondar to identify the socio-economic and demographic factors determining the level of poverty. This study uses the following methodology to assess factors that determine poverty in Gondar city.

4 Methodological framework

The study uses both qualitative and quantitative techniques. Data on main determinants of poverty are collected from 12 urban Kebeles of 23 urban & rural kebeles of Gondar city. The remaining 11 Kebeles are excluded because of time and budgetary constraints. The main respondents for the interview were household heads. A representative sample was drawn from the list of households kept in each kebele office based on housing number. The sample size was determined using Fowler (2002) method as cited in Esubalew (2006).

$$n = \frac{(Z_\alpha / 2)^2 \, p.q}{D^2} \qquad \text{... (1)}$$

where n = Sample size, $\alpha/2$ = the two tailed critical value at 5% level (1.96). P = probability of Gondar city poverty incidence, q = 1- p. D = marginal error between the sample and the population size (0.05).

The researcher took 0.18 as the incidence rate of Gondar, which is obtained from poverty profile of Ethiopian urban centers (MoFED, 2002). Equation (1) suggests the sample size (n) to be 226. The researcher added additional 14 target households to undertake survey on a total of 240 households.

Both stratified and systematic random sampling techniques are employed to conduct this study. First, the total households in all of the 12 kebeles are considered as strata within their respective kebele, and then samples were drawn proportionally from each kebele population to determine the number of samples in the selected kebeles[4]. Information from secondary sources including key stakeholders such as the Mayor's Office, Finance and Economic Development Office and Gondar Service (Municipality) Office was also collected to supplement the primary data.

Descriptive statistics like percentage, frequency, standard deviation, chi square and etc are used to interpret the results. Arc view is also utilized for better visualization of the result. Excel, SPSS, StatsDirect and STATA software are employed to determine the coefficients of determinant factors and to compute other statistical values.

To measure poverty and identify the poor from non-poor empirical models are utilized. Foseter Greer Thorbeck (1986) food energy intake approach and Rowntree's (1901) cost of basic needs are used to determine absolute poverty line of the households (Kakwani, 2003). According to Nanak Kakwani (2003), Greer and Thorbecke (1986) proposed the method of computing the food poverty line at which a person's food energy intake is just sufficient to satisfy a given required quantity of his or her daily calories. They estimated the following cost of calorie function.

$$\ln Y_j = a + bC_j \qquad ...(2)$$

where Y_j = the expenditure on a basket of food that is actually consumed by households per adult equivalent C_j= the number of calories that are obtained from the food basket per adult equivalent. If R is the recommended calorie requirement, then food poverty line Z^f is estimated as (Ibid, 2003):

$$Z^f = e^{(a+bR)} \qquad ...(3)$$

Where, Z^f = food poverty line, R = recommended calorie requirement per adult equivalent, which is 2200 for Ethiopia and, a and b are parameters estimated from equation 2.

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[4] The number of samples drawn from each kebele based on the proportionate stratified sampling is presented in Annex 2.

A person is identified as poor if his or her food expenditure is less than the needed to meet the food poverty line. This poverty line is interpreted as the food expenditure level at which a typical individual's nutritional needs are met. To consider inter-personal variation in consumption, researchers usually utilize the standard approach, called the "adult equivalent household size" (Banks and Johnson, 1994, Decton, 1999, FAO, 2005):

$$H_i = (A + \gamma K)^{\theta} \qquad ...(4)$$

where, A = number of adults, K = number of children, γ= the cost of children relative to adult, θ = household economies of scale, γ and θ are parameters which lie between 0 and 1. The value of γ is 0.5 and θ is 0.95 in comparable studies. Thus, this study also utilizes these values to compute the adult equivalent household size.

After the food poverty line is estimated using Equation (3), total poverty line can be calculated adding some allowance for non-food items. We begin with a demand function for food representing the food share as linear function of the log of total spending (food plus non-food) in relation to food poverty line (Ravallion and Bidani, 1994).

$$S_i = \alpha + \beta \log(x_i / z^f) + e \qquad ...(5)$$

where, S_i = the share of expenditure devoted to food i, x_i = total expenditure (food plus nonfood), z^{f} = food poverty line, α and β are parameters to be estimated.

It is also suggested that the square value of log (x_i/z^f) will probably allow a better fit to the data if $x_i = z^f$, because it permits the income elasticity of demand for food to exceed unity at low value of x (Ibid, 1994). Then total poverty line Z is given by:

$$Z = z^f (2 - \alpha) \qquad ...(6)$$

In words, total poverty line is obtained by scaling up the food poverty line, the proportionate increase being given by the estimated non-food budget share at the food poverty line. After food poverty line and total poverty line are estimated using equations 3 and 6 respectively, poverty indices such as P_0, P_1, and P_2 can be estimated using Foster Greer Thorbeck (1986) formula:

$$P_\alpha = \frac{1}{n} \sum_{i=1}^{q} (\frac{z - x_i}{z})^{\alpha}, \text{ where } \alpha = 0, \qquad ...(7)$$

where, z = food poverty line, x_i = consumption expenditure q= number of households below poverty line, n = total number of sample households, α = 0, 1, and 2 which represents p_0 , p_1, and p_2 of head count, poverty gap, and severity of poverty respectively.

The study uses Gini Coefficient of inequality to measure the income distribution of the study area. Statsdirect software will be used to estimate the Gini coefficient. It ranges from zero to one, where Gini equals zero implies perfect equality and equals one implies perfect inequality or full disparity in income distribution (Todaro and Smith. 2009).

The Logit Model

After poverty lines and poverty indices are determined using the above series of equations, we use logit model to identify factors determining poverty. The dependent variable is dichotomous that takes values as households are poor 1 and non-poor 0. In Logit model the impact of predictor variables is usually explained in terms of odds ratio. The logistic regression calculates changes in log odds of the dependent, not changes in the dependent itself. Logit model is specified following Gujarati (2004) as:

$$Y_i = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + ... + \beta_k X_{ik} + \varepsilon_i \qquad .....(8)$$

where Y = Probability of a household being poor or non-poor, α = Intercept (constant) term, β_i =Coefficients of the predictors estimated using the maximum likelihood method, X_i= Predictors (independent variables) and ε = error term.

Aggregating the value of Equation (8) yields

$$Y_i = \alpha + \sum_{j=1}^{k} \beta_{ij} X_j + \varepsilon_i \qquad ....(8.1)$$

In practice Y is unobserved, and ε is symmetrically distributed with zero mean and has cumulative distribution function (CDF) defined as F (ε). What we observe is a dummy variable y, a realization of a binomial process defined by

$$y = \begin{cases} 1 \text{ if } y > 0 \\ 0 \text{ otherwise} \end{cases} \qquad ...(8.2)$$

Combining (8.1) and (8.2) and leaving the constant term in (8.1) gives:

$$\begin{aligned}\text{Prob}(y=1) &= \text{Prob}\left[\sum_{j=1}^{K}\beta_j + \varepsilon > 0\right]\\ &= \text{Prob}\left(\varepsilon > -\sum_{j=1}^{K}\beta_j X_j\right) \qquad \text{...(8.3)}\\ &= 1 - F\left(-\sum_{j=1}^{K}\beta_j X_j\right)\end{aligned}$$

The Logit model usually takes two forms. It may be expressed in terms of Logit or in terms of event probability. When it is expressed in Logit form, the model is given as

$$\log\left[\frac{P(y=1)}{1-P(y=1)}\right] = \sum_{j=1}^{K}\beta_j X_j \qquad \text{...(8.4)}$$

Equation 8.3 and 8.4 can be transformed into a specification of the Logit model of event probability by replacing the general cumulative distribution function (CDF), F, with a specific CDF, L representing the Logistic distribution.

$$\text{Prob}(y=1) = 1 - L\left[\sum_{j=1}^{K}\beta_j X_j\right] = L\left[\sum_{j=1}^{K}\beta_j X_j\right] = \frac{e^{\left(\sum_{j=1}^{K}\beta_j X_j\right)}}{1+e^{\left(\sum_{j=1}^{K}\beta_j X_j\right)}} \qquad \text{...(8.5)}$$

$$\text{Prob}(y=0) = \left[-\sum_{j=1}^{K}\beta_j X_j\right] = L\left[\sum_{j=1}^{K}\beta_j X_j\right] = \frac{e^{\left(\sum_{j=1}^{K}\beta_j X_j\right)}}{1+e^{\left(\sum_{j=1}^{K}\beta_j X_j\right)}} \qquad \text{...(8.6)}$$

Thus equation 8.5 gives us the probability of being poor [Prob (Y=1)] or probability of an event occurring and equation 8.6 gives the probability of being non-poor [Prob(Y=0)], which is 1 minus the event probability.

The independent variables (x_i) included in equation 8 are explained below based on theory and empirical evidences.

Gender of Household Head (ghhh): In most literatures, it has been found that female headed households are poorer than male headed households. For instance, Bigsten et al (2005) finds female-headed households were more likely to be below the poverty lines in both rural and urban areas of Ethiopia. In order to test this hypothesis a dummy variable is to be used to indicate whether the gender of the head of the household related to poverty or not. The researcher gives a value of 1 if the head of the household is female as poor (1) and (0) otherwise.

Household size (hhsize): Lanjouw and Ravallion (1994), Lipton and Ravallion (1993), Bigsten et al (2005) assert that households with increased family size are positively correlated with being poor or below the poverty line. In this study also the researcher expects that larger household sizes are likely to be poorer than those with less family sizes.

Proportion of Female in Household (prowomen): Lilongwe and Zomba (2001) found in Malawi the addition of a female adult reduces per capita consumption in urban households. On the contrary, Fagernäs and Wallace (2007) found in Sierra Leon that household welfare rises with the share of women in the household in rural areas and worse off in Freetown. In the case of Gondar the researcher expects that the higher the proportion of female in a household the more will be the probability of facing poverty.

Dependency Raito (depratio): This is calculated as the ratio of the number of family members not in the labor force (children and aged) to those in the labor force in the household. One might expect that a high dependency ratio will be associated with greater poverty. Mok et al (2007) provide evidence in Malaysia that higher proportion of children under 15 years of age increase the probability of a household falling into poverty.

Marital Status (marstatus): This is a dummy variable used to indicate whether or not the spouse of the head of the household lives in the household. Single-parent families are more likely to be poor than two-parent families. The reason is that as one gets married there would be additional labor force and economies of scale in the household.

Housing ownership: Lack of housing title and low quality housing strongly correlates with poverty. Poverty is a cause for low quality of housing and lack of ownership of residences. Households not owning a house are expected to be associated positively with the status of being poor and those owning house as not poor.

Employment type (emptype): In Mexico Garza-Rodriguez (2001) proved that working in a professional occupation or in a middle level occupation decreases the probability of being poor. This study also expects households with formal employment type are less likely to be poor and households with informal/casual employment type will more likely be poor.

Age of Household Head (agehh): According to life-cycle theories poverty is relatively high at young ages, decreases during middle age and then increases again at old age. Households with older or younger household heads may be more likely to consume less than those with heads of household who are of working age. This study uses square of age whether or not the age of household head is related to the probability of being poor in line with the productivity of theory.

Education: Alemayehu et al (2005) in Kenya found a negative correlation between education and the probability of being poor. In this study dummy variable is used to capture the status of the household head as educated or not with a threshold level of education being grade eight. The expectation of the study is a negative correlation between the attainment of secondary education and above of the head of the household and the probability of being poor.

Education of parent (edu father) (edu mother): It is expected that households where the parents of the head of the household had no education would be worse-off than households where the parents were educated. A dummy variable with a value of 1 is given to household head's with parents of no education up to grade eight and zero otherwise. This is a test for whether the lack of education and resulting poverty persists from generation to generation.

Disease (sickm): when the household head become sick, this has a subsequent impact on the income and welfare of the household. Furthermore ill health is associated with additional or increased health care costs. In this study the researcher found that if more than one member (or frequently one member) of the household is sick, the probability of being poor will be high.

Access to Basic Services (access): The variable, which measures access to general infrastructure at the household level in Malawi shows that the more time in hours it takes on average to reach the health center, bank, bus station, or post-office the more negative is the marginal effect on welfare (Lilongwe and Zomba, 2001). In this study, if the household gets all basic services such as primary education, health station, potable drinking water, paved roads, police station, market, and banks in more than one kilo meter on average distance, it is expected to increase the probability of being poor. Therefore, a dummy variable is used and if the household gets on average all services below one kilo meter they would be considered as non-poor otherwise poor.

Income: poverty includes lack of income but lack of income is not only measurement of poverty. Low income is its sign because it affects directly the well-being of households or individuals. Lack of income means lack of access/opportunity to purchase goods and services. On the contrary, as one's income increases its

purchasing power also increases *citrus paribus*. This study expected that the higher the income the household produced, the lower the probability of being poor.
Remittances (hhremt): Remittance can be considered an extra source of income; it is likely to improve household welfare. In the study area there are many people who get remittance and this might have effect on poverty status of the people. The researcher assumes that households that do not get remittance poor (1) otherwise (0) non-poor.

5. Results and discussions

5.1. Poverty line and poverty status

In this study food energy intake (FEI), and cost of basic needs approach (CBN) that permits some allowance for non-food items are employed to determine poverty line. Regression of natural logarithm of expenditure as dependent and daily calorie intake as independent variable is used to compute the parameters in equation 2.

LnY	1.104016	+	$0.000341C_j$
	(0.035982)		(1.26075)

Adjusted -R2 = 0.754

Both parameters are found to be statistically significant (given figures in the parentheses are standard errors) and thus using equation 3, we then determine food poverty line that is $Z^f = e^{(1.10402 + 0.00034*2200)}$ = 6.38 Birr per day. This poverty line is interpreted as the food expenditure level at which a typical individuals' nutritional needs are met.

In Gondar city, people who have expenditure of below Birr 6.38 are considered below food poverty line (poor) and those spending more than birr 6.38 are categorized in the above food poverty line (not poor). When head count poverty is estimated based on this line (6.38 Birr), from the total population of the survey 24.6% are below food poverty line and the remaining 75.4% are above poverty line. People in urban areas are characterized by monetized economy. They are not only spending money on food items but also clothing, education, health, and other socio-economic activities require spending of money. As the data obtained in this study show households spend 58.4% of their income for food and 41.6% for non-food items.

Thus, computing total poverty line that includes food and non-food spending is inevitable. To determine total poverty line, the food poverty line Birr 6.38 and some allowance for non-food items should be included. According to Revallion and Bidani (1994), households usually spend on nonfood goods even though they do not reach the minimum nutritional requirement since some non-food items are similarly basic.

Thus to determine poverty line that includes the cost of non-food items, we first regressed the demand function indicated in equation 5 to compute the parameter $\alpha = 0.624958$ and $\beta = 0.49107$ results. Then after total poverty line Z is then determined using equation 6 as:

Table 1: Poverty status of Gondar city by kebele

Kebele	Poor	%	not poor	%	Total	%
Abajalie	7	2.9	14	5.83	21	8.75
Abeye Egzi	9	3.8	8	3.33	17	7.08
Adebabay Eyesus	3	1.3	11	4.58	14	5.83
Arbegnoch Adebabay	5	2.1	11	4.58	16	6.67
Azezo Ayermarfeya	7	2.9	15	6.25	22	9.17
Azezo Demaza	10	4.2	12	5.00	22	9.17
Gebrieal Akababi	4	1.7	12	5.00	16	6.67
Kirkos Akababi	12	5.0	13	5.42	25	10.42
Iedeta	5	2.1	17	7.08	22	9.17
Maraki	7	2.9	21	8.75	28	11.67
Medihaniealm Akababi	4	1.7	14	5.83	18	7.50
Mehal Arada	6	2.5	13	5.42	19	7.92
Grand Total	79	32.9	161	67.08	240	100.00

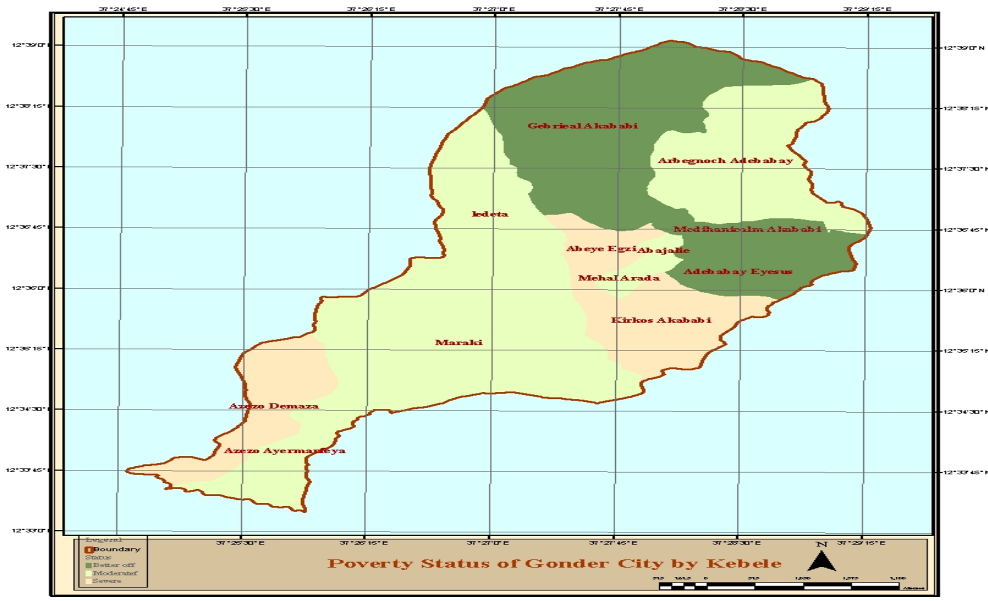
Source: Author's household field survey of 2009

$Z = 6.38(2-0.624958) = 8.77$ Birr per day per adult equivalent.

The estimation of the poverty line is based on adult equivalent consumption of basic needs and thus, people who spend below Birr 8.77 per adult equivalent per day is poor, and those who spend above Birr 8.77 are non-poor.

The findings of the survey in Table 1 indicate that people living below total poverty are found to be 32.9 %, whereas 67.1 % are above poverty line. The highest poverty incidence is found in Kirkos Akababi followed by Azezo Demaza and Abeye Egzie kebele respectively. The share of poverty indicated from Table 1 is calculated from the total sample of respondents of Gondar city. However, when the incidence of poverty is calculated based on respondents of each own kebele, the result becomes different from the one indicated in Table 1. For instance, the incidence of poverty in Abeye Egzie is found to be 52.9%, followed by 48% Kirkos Akababi and 45.4% Azezo Demaza respectively, implying these percentage of people live below poverty line of 8.77 Birr per adult per day.

Figure 1: Poverty pattern of Gondar City by Kebele



Source: Author's Household Field Survey of 2009 and BoFED.

As shown in Figure 1, there is a relatively high poverty incidence in rose colored kebeles (Kirkos Akababi, Azezo Demaza and Abeye Egzi) with a share of 5%, 4.2% and 3.8% of the poor in the city respectively. Azezo Demaza is home of many x-soldiers and they are poorly accessible of public infrastructures. Kirkos Akababi includes areas like Addis Alem, which have not been still accessible to basic infrastructures like road, education, telecommunication and housing security. Most of the population of Abeyeegzie is found in fragile area and poor infrastructures that is not conducive for business. These natural and man-made obstacles hampered households to be out of the poverty line in these specific locations.

On the other side, the green colored administrative areas, such as Adebabay Eyesus that has a share of 1.3% and Medihaniealm Akababi and Gebriel Akababi each accounting 1.7% are found to be better off administrative kebele's of Gondar city. The better off administrative areas are mainly known to be the center of residence of public servants and many government offices and business firms including private and government banks, insurances, and basic services. As a result households in this location can utilize the advantages of this geographical location and become accessible to earn more income and lead their life better than other kebele residences (Getachew, 2009). The gray colored kebeles are found to be moderate or between the two extreme poverty statuses.

5.2 Poverty Indices

Head count, poverty gap and poverty severity indices are computed using Equation 7 and the results are shown below.

Table 2: Poverty Indices

Type of poverty line	P_o= head count	P_1= poverty gap	P_2= poverty severity
Food poverty line	0.246	0.0598	0.0233
Total poverty line	0.329	0.0704	0.0225
$1 a day poverty line	0.375	0.0650	0.0233

Source: Author's household field survey of 2009

Incidence of Poverty or Head Count Index P_o: The results indicates that the proportions of people that live below poverty line were 24.6 % and 32.9% for food and total poverty (food and non-food items) respectively. When the poverty status of Gondar city is measured based on $1 a day poverty line, the proportion of people living below poverty line becomes 37.5%, which is slightly over the 35% poverty head count of Ethiopian urban areas (MoFED, 2006).

The food energy intake or food poverty index indicates that 24.6 % of the surveyed population cannot afford to buy or consume basic basket of goods that satisfy their nutritional needs. However, when the expenditure on non-food items such as house rent, clothing, education and health expenditure, electric and water bill payment etc are added, the share of the population living below the poverty line becomes 32.9%. This result implies that the food poverty index (24.6) is lower than basic necessities index (32.9) implying that households in relative terms scarity their needs and switch the expenditure to other goods towards their daily bread.

Depth of poverty or poverty gap P_1: Poverty gap index shows the amount that should be transferred to the poor with right targeting to bring all the poor out of poverty. In other words each poor should get exactly their income or expenditure shortfalls (the amount he/she needs) to be lift out of poverty. The depth or poverty gap p_1 of Gondar city is 5.98% for food and 7.04 % for food plus non-food consumptions.

Poverty Severity (squared severity gap) P_2: The measure reflects as the sum of two components: an amount due to the poverty gap and an amount due to inequality amongst the poor. The value of this index is higher for households far away from the poverty line. In addition high value p_2 for a specific kebele indicates that the severity of poverty for people living in that kebele is higher. Thus the p_2 results of households' survey in Gondar are 0.0233 and 0.0225 for food, and food plus nonfood consumption respectively.

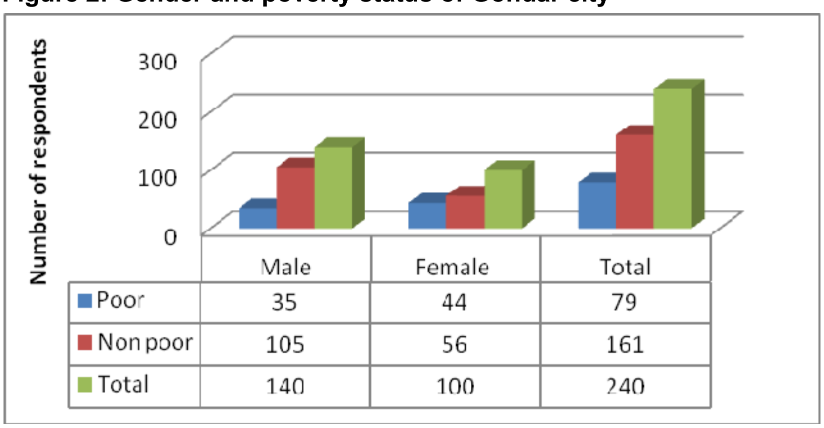
5.3 Descriptive analysis of urban household poverty

As mentioned earlier the descriptive statistics of this study is based on socio-economic and demographic characteristics of the data obtained in household survey of Gondar city. Total poverty line (food plus non-food consumption expenditures) is used as reference to identify the poor from the non-poor households.

5.3.1 Gender and poverty

Due to socio-economic factors poor women-headed households are greater than their men counterparts. Studies try to identify several underlying causes for the income inequality between men and women. Women have less access to productive capital, asset, paid labor, education and decision making. They are discriminated against gainful employment, in political, social and economic decision making process. These and other factors make many women more vulnerable and live below the poverty line.

Figure 2: Gender and poverty status of Gondar city



Source: Author's household field survey of 2009

The respondents of this study are found to be 41.7 % female household heads and 58.3% male household heads. Within female-headed households, 44 % of them are found to be poor and 56 % are non-poor. Of the total male-headed households only 25% of the male-headed are poor and the rest 75 % are non-poor. From the total of households which lie below the poverty line 55.7 % are female-headed and the remaining 44.3 percent are male headed. The chi-square test $x^2(1)$ =9.537, P>value =0.002 shows significance at 95 confidence interval, implying that poverty affects female-headed household more than their male counterparts.

5.3.2. Poverty and household size

In developing countries parents increase children in order to increase the probability that they get economic support when they become old. Child labor is also a usual practice to generate income in such countries (Fagernas and Wallace, 2003). Presence of high infant mortality rates particularly among the poor also tends to cause excess replacement births. This leads to increase household size and then pushes to poverty. The situation of household size and poverty in the study area is presented below.

Table 3: Poverty and household size in Gondar city

Household Size	Poor		Not Poor		Total	
Household size	(Number of Households)	%	(Number of Households)	%	Number of Households	%
Five & below	26	32.9	56	34.8	82	34.2
Six & Above	53	67.1	105	65.2	158	65.8
Total	79	100	161	100	240	100

Source: Author's household field survey of 2009

Minimum and maximum household size of the study area is 1 and 14 respectively. The average family size was five people per household. As shown in Table 3 the share of poor households within the category of household size five and below were 32.9% of the total poor. Households that have household size of above the average takes the lion share, which is 67% of the total poor. The result is consistent with the theory that says as the household size increases the probability of the household to fall in to poverty increases. For example Fagernäs and Wallace (2003) found in Sierra Leone that poorer households tended to be larger in household size than non-poor households (6.5 people compared with 5.5).

5.3.3. Poverty and education of households

When an individual gets better education, it is expected that his or her productivity, skill, bargaining power and competitiveness of the individual in the labor market as well as in the social setup become higher. This in turn helps households to earn more income and reduces the probability to be impoverished. On the other side, poverty limits investment on education and leads households to be poorer.

Table 4: Poverty and Household Head Education

Education Level	Poor		Non-poor		Total	
	Number of Households	%	Number of Households	%	Number of Households	%
Grade 8 & Below	55	69.6	62	38.5	117	48.8
Grade 9 -12	16	20.3	48	29.8	64	26.7
Certificate & Diploma	8	10.1	34	21.1	42	17.5
Degree and Above	0	0	17	10.6	17	7.1
Total	79	100	161	100	240	100

Source: Author's household field survey of 2009

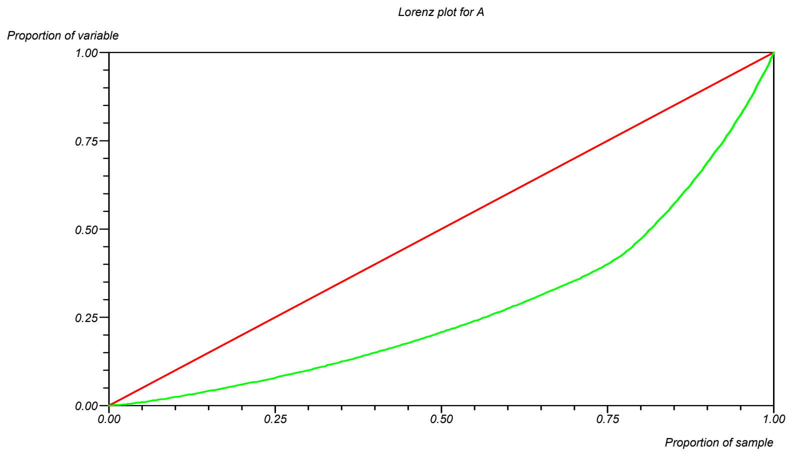
As depicted in Table 4, the household heads which are in the category of grade 8 and below including illiterates take 69.6% of the total poor. In contrast the share of poor households declines as we go to higher level of education categories and reaches zero at level of degree and above. When we see the non-poor column, about 61.5% of households attained relatively high level education (grade 9 and above). In line with the theory, this implies that as the education level of households increases, their probability of being poor decreases and the vice versa. Thus, the outcome of the survey asserted that the number of poor households increases as the household educational attainment became grade 8 and below educational category.

5.3.4. Income inequality and poverty

In the study area, the respondent income of households was found to range between 257 to 11831.50 Birr per month. The average household income and average income of an individual per adult equivalent were found to be 1735 and 263 Birr per month respectively.

This study uses Gini Coefficient (Todaro and Smith, 2009) of inequality to measure the income distribution of the study area. The Gini coefficient ranges from zero to one, where Gini equals zero implies perfect equality and equals one implies perfect inequality or full disparity in income distribution. The Lorenz curve is plotted in the x-axis and y-axis. Commutative proportion of sample households is plotted in the x-axis and commutative proportion of variable income in the y-axis. Inequality is greater, the farther the Lorenz curve bends away from 45^0 line. Thus as the diagonal moves far away from the 45^0 straight line in the curve which is line of perfect equality, income inequality would increase and the vice versa. In the study area, the Gini coefficient was plotted using StatsDirect software.

Figure 3: Lorenz plot for income



Source: Author's Calculation based on Household Field Survey of 2009.

The Gini coefficient of sample households is found to be around 0.44; with 95 percent confidence interval contains the value with the range of 0.415233 to 0.455147. It means 44% of the income was distributed unequally. In practice values measured in national income distributions in many countries have a narrower range, ordinarily from about 0.25 – 0.60 (MoFED,2006). Even though the Gini coefficient result of the study area lies in the range of internationally recognized category, the magnitude of inequality in the distribution of income and thus expenditure is considerable in the study area. This indicates that smaller number of citizens own large share of the city income whereas large number of citizens suffer from abject poverty. Practically poor households fall in the category of large number of people with small share of income and then expenditure. This is the truth and this coefficient tends to rise as richer people become richer at a faster rate than poor people become richer. This implies even if absolute poverty declines the coefficient can tend to increase. In a market-led economy, there is little to do to avoid relative poverty; if anything the focus should be more on addressing absolute poverty. The focus of the government is to address absolute poverty through encouraging activities that use labour intensive technologies while at the same time allowing investors who can come up with capital intensive technologies.

5.4 Econometric analysis of the determinants of poverty

Many regression methods are based on the assumption of homoscedasticity. In logit, the assumption of equal variance is not expected. Cook Weisberg test for hetroscedasticity (hettest) using fitted values of poverty is carried out in stata software. The result of Chi-square $x^2(1) = 13.96$ rejects the null hypothesis of constant variance. The study tried to check whether multicollinarity exits asserted that standard errors are not so high implies no problem of multicollinearity. In addition the mean value of VIF is 1.38. This implies that there is less and acceptable collinearity. In this study omitted variable test has been conducted, Ramsey RESET test using powers of the fitted values of poverty. The results indicates that F (3,222) =17.56 and we accept the null hypothesis of no omitted variables.

Model's Prediction Power

In order to assess the predictive power of the model a classification table of correct and incorrect predictions is constructed based on the predicted probability of being poor. The constructed classification table shows that 75 of the 79 (94.9%) poor households are correctly predicted as poor by the model and 155 of the161 (96.3%) non-poor households are correctly predicted as non-poor. Cumulatively, 95.8% of the 240 cases were correctly predicted by the model and thus, the model fits the data. Having conducted the above tests, the determinants of poverty are estimated using logit model and stata software. The model result of the determinants of the socio-economic and demographic factors are presented in table 5 and 6.

Table 5: Logit Estimates of Determinants

```
Logistic regression                               Number of obs   =        240
                                                    LR chi2( 14)     =     241.87
                                                    Prob > chi2      =     0.0000
Log likelihood =  -36.783756                        Pseudo R2        =     0.7668
```

hhp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ghhh	.4397594	.9902201	0.44	0.657	-1.501036	2.380555
hhsize	2.225992	.8242872	2.70	0.007	.6104183	3.841565
prowom	.3467494	.7342558	0.47	0.637	-1.092366	1.785864
depratio	1.340999	.8155474	1.64	0.100	-.257445	2.939442
marstats	2.089111	.9673564	2.16	0.031	.1931275	3.985095
house	-1.778802	.7442593	-2.39	0.017	-3.237523	-.3200801
empntype	2.156489	.8062702	2.67	0.007	.5762283	3.73675
agehh	-1.297925	.7983036	-1.63	0.104	-2.862572	.266721
eductnhh	-2.613995	.9661123	-2.71	0.007	-4.50754	-.7204495
hhfedutn	-.7289056	.9525674	-0.77	0.444	-2.595903	1.138092
sicknmbr	2.320097	.8902665	2.61	0.009	.5752062	4.064987
access	1.253743	.7459869	1.68	0.093	-.2083643	2.715851
mothincm	-2.541327	.7719163	-3.29	0.001	-4.054255	-1.028399
rmitance	-1.591303	.7420944	-2.14	0.032	-3.045782	-.1368248
_cons	-.753974	1.530709	-0.49	0.622	-3.754108	2.24616

Source: Author's household field survey of 2009

Even though many variables are used to assess the correlate with poverty, as depicted in Table 5, only household size (hhsize), frequent disease (sicknumbr), marital status (marstats), ownership of house (house), employment type (empntype), education of household head (eductnhh), average income of adult equivalent per month (mothincm), and remittance of the household (rmitance) are found to be significant. The coefficients represent the odds of each explanatory variable and their respective signs show the relation of each variable with poverty status of households. The odds ratio of the explanatory variables with respect to the probability of households to being poor is indicated in Table 6 below.

Table 6: Estimates of odds ratio

```
Logistic regression                               Number of obs   =        240
                                                    LR chi2(14)     =     241.87
                                                    Prob > chi2     =     0.0000
Log likelihood =  -36.783756                        Pseudo R2       =     0.7668
```

hhp	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ghhh	1.552334	1.537152	0.44	0.657	.222899	10.8109
hhsize	9.262663	7.635095	2.70	0.007	1.841201	46.59834
prowom	1.414462	1.038577	0.47	0.637	.3354221	5.964733
depratio	3.822859	3.117723	1.64	0.100	.7730242	18.9053
marstats	8.077732	7.814046	2.16	0.031	1.213037	53.79039
house	.1688404	.125661	-2.39	0.017	.039261	.7260908
empntype	8.640746	6.966776	2.67	0.007	1.779315	41.96137
agehh	.2730978	.218015	-1.63	0.104	.0571217	1.305676
eductnhh	.0732414	.0707594	-2.71	0.007	.0110255	.4865335
hhfedutn	.4824367	.4595535	-0.77	0.444	.0745785	3.120809
sicknmbr	10.17666	9.059936	2.61	0.009	1.777497	58.26414
access	3.503433	2.613515	1.68	0.093	.8119112	15.11747
mothincm	.0787618	.0607975	-3.29	0.001	.0173484	.3575791
rmitance	.20366	.151135	-2.14	0.032	.0475591	.872123

The interpretation below is based on the odds in Table 5 and the odds ratio indicated on Table 6. The positive value of household employment type indicates that as households are working in informal and casual work, the probability of being poor increases, while the probability of households who work in formal or public occupations decreases the probability of households to be poor. Households are assumed to earn more income in a formal and permanent work type than the casual or informal work types. The variable household employment type logit estimation shows positive and statistically significant outcome, implying that as household informal employment increases by one, *citrus paribu*s (while the value of all other variables remaining constant),the odds and odds ratio of households of being poor will be increased by factor of 2.15 and 8.64 respectively.

Marital status of household also shows statistically significant result, implying that as the household gets single, *ceteris paribus* (keeping other variables unchanged), the odds and odds ratio of being poor increases by factors of 2.08 and 8.077 respectively. This implies that when people get into marriage, the probability of falling into poverty diminishes. The household can utilize the advantages of economies of scale and marriage can bring additional work force that helps to increase the household income.

On the other hand; as the family size of the household increases by a unit, the odds and the odds ratio, keeping all other variables constant, increases by a factor of 2.22 and 9.26 respectively indicating a positive relationship between household size and poverty. This result tends to imply that addition of a household member pushes the household to poverty.

Similarly, if the adult equivalent monthly household income exceeds the average monthly income, remaining other variables unchanged, the odds and odds ratio of households being poor decreases by factors of 2.54 and 0.078 respectively. Thus, improving income generating opportunities of households through different options would be an important step towards poverty reduction policies and strategies, particularly for the city of Gondar. Ownership of a residence is also negatively related with the probability of falling to poverty. As shown in the odds and odds ratio tables, as the households own a house, the odds and odds ratio of being poor decreases by a factor of 1.77 and 0.168 respectively.

Completing primary education of the household head is found to be associated with poverty. The results obtained from the model reveals that as the heads of the household completed primary education, ceteris paribus, the odds and odds ratio of the household being poor decreases by a factor of 2.61, and 0.073 respectively. This implies that lack of education is a factor that pushes households to fall into poverty. Therefore, promotion of education to citizens become; central in addressing problems of poverty especially completing primary level education is found to have a paramount importance in reducing poverty.

Similar to income, remittance of households shows negative relation with the probability of being poor. As the household gets remittance the odds and odds ratio of a household falling into poverty declines by factors 1.59 and 0.203 in that order. As it is expected, sickness has a positive correlation with the probability of households to be poor. When the household becomes sick, there will be cost of medication, joblessness and loss of productivity. On the other side, if the household is poor, members of the household may not be able to have balanced food and have no resistance to different communicable diseases. Thus, poverty and frequent occurrence of sickness of household members are reinforced each other and are strongly correlated. The results of the model shows that the odds and odds ratio of a household being to poor increases by factors of 2.32 and 10.17 respectively.

The average distances of basic services are also taken to see the effect of access to basic services in determining poverty. The basic services taken in the study were distance from main road, market, primary education, health station, tap water source, police station and banks. If a household is accessible for these basic services averagely within one kilo meter, she/he is considered as non-poor and if not as poor. Even though the variable access to basic services became negative correlate with the probability of being poor, it became significant at 10 percent level of significant.

6. Conclusions and recommendation

6.1. Conclusion

The objective of this study was to assess the level of poverty and identify determinants of poverty among urban households of Gondar City based on socio-economic and demographic characteristics of respondent households and other secondary data.

The computed poverty lines of the whole sample were 6.38 Birr for food and 8.77 Birr for food plus non-food items per day. A dollar was also considered as a poverty line to identify the poor from the non-poor for comparison purpose. Of the total 240 respondents the study found that 24.6% of them live below food poverty line, 32.9% below food plus non-food (total) poverty line and 37.5% below a dollar a day poverty line.

The poverty incidence of Gondar city was found to be very high, though it was found less than the Ethiopian urban areas poverty incidence of 35%. The outcome of this study indicates increment of poverty incidence of Gondar city itself from 17.5% (MoFED, 2002) to 32.9%. The proportions of poor people who live below the international poverty line were more than the proportions of people identified as poor using total poverty line.

In Gondar city 44% of the income was distributed unequally. This is similar to Ethiopian urban areas (Ibid, 2002) but more than the 30% unequally distributed income of the rural and urban average of Ethiopia (MoFED, 2006). Therefore, besides the level of poverty, highly inequitable distribution of income in the study area should be a concern for policy makers and other stakeholders dealing on poverty.

The intensity of poverty greatly varies among the different kebele administrative areas. Kirkos Akababi, Azezo Demaza and Abeye Egzi kebele administrative areas are highly poverty affected areas with share of 5%, 4.2% and 3.8% of total respondents respectively. The main reasons of the case were found to be improperness of the location for business or income generating activities partly because of weak infrastructure networks.

Education level of the household head is found to be an important variable that negatively affects urban poverty. Many of the households that have completed primary education were found to be non-poor. Households with education level of degree and above haven't been found in the poor category. The econometrics regression result also reveals that education and poverty are negatively related. Health of households was found to be having significant correlation with poverty of households. Households that have sick household member frequently reported is more likely to be poor than others. This implies that intervention to expand the coverage of education and health services has a paramount impact on alleviating poverty at the household level and beyond.

It is found that female-headed households are poorer than male. Unmarried, widowed and divorced households are poorer than the married ones. It could be because as the household became widowed or divorced, all responsibility of the household lies on one shoulder and this makes the head incapable to earn more income or generate additional resource. The married households are found with higher probabilities in the non-poor category than others.

Household size is found to be positive and significantly correlated with poverty. The residents of Gondar with large household size tend to fall into poverty more easily as compared to those who have average and small family size.

Income of households is negatively correlated with probability of being poor. Though income is not the only measure of poverty, it is found that households that lack income are also in deficiency of resources like house, education attainment, and other infrastructures. The study also found that households who get remittance are less likely to be poor than those who do not. Informal employment positively relates with the probability of being poor but formal employments relate negatively as theories and empirical findings elsewhere suggest. Housing ownership is found to be statistical by significant and negatively correlated with the probability of households to be poor. As households own houses, the costs that were to be paid as house rent became saved and the house itself is used for households as a productive asset. Households inaccessible to basic services are more likely to be poor than otherwise with 10 percent of level of significance.

6.2. Recommendations

Poverty can be addressed through different ways. In the study area, we suggest the following intervention areas to be considered in policy formulation, planning and implementation of programs, projects and other activities.

Kebele administrative areas have different poverty status and thus the city administration or other stakeholders should target poverty alleviation measures based on poverty status of administrative areas or locations.

Expanding education coverage at all levels including higher education and technical and vocational colleges should be given prior emphasis. Focusing more on female education should be a fundamental part of poverty reduction policies because female education enables to attain double goals; enhancing education attainments to increase the productivity and job security of females, and impact on household size because fertility is negatively correlated with female education.

To reduce poverty in the area, awareness creation on the poverty effect of large family size as well as family planning coverage should be expanded. This calls for overall city health extension services in general and focus on poor households in particular.

To reduce unemployment, poverty and hence increases income in the study area, labour intensive employment generation schemes need to be designed and implemented. In this regard, skill-based training and credit facilities for unemployed as well as casual workers have to be provided so as to help to increase the income of the poor and reduce income inequality.

Encouraging and supporting households to own houses as a venue for performing income generating production and services activities should be another remedial measure to minimize urban household poverty. This can be in the form of free and fast land delivery for housing construction, affordable credit facility, and other mechanisms.

In addition, basic infrastructure access to all urban households enables to reduce poverty at the city level in general and helps to bring out poor households that have currently fallen in the poverty category.

Overall, this study has shown that poverty incidence of Gondar city is found to be very high. Therefore, the city administration and other stakeholders have to take measures on the determinant factors to hamper the poverty at the city as well as household level.

Based on this study as benchmark the city is recommended to undertake a more comprehensive study in terms of area and sample coverage and other variables including good governance, property right and their law enforcement so as to get a more realistic picture for well planned and more pragmatic intervention.

Finally, the poverty incidences and other socio-economic and demographic variables of Gondar city have shown the difficulties of households to break the vicious circle of poverty. Unless integrated efforts are undertaken to fight against poverty, the condition of poor households will continue to exist. Therefore, joint efforts should be undertaken at all levels including the government, non-governmental organizations, community based organizations, researchers, the poor themselves, and other stakeholders.

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Annex 1: Assumptions of Variables Used in the Estimated Equations

Variables	Assumption
Dependent Variable	
Urban Poverty (hhp)	1 if poor, 0 otherwise
Explanatory Variables	
Age (hhage)	1 for 18-30 and >60,0 otherwise
sex of household heade (ghhh)	1 for female, 0 otherwise
Proportion of female in the household (propw)	1 if > 0.5, 0 otherwise
Dependency ratio (depratio)	1 if > 0.4, 0 otherwise
Marital Status (marstatus)	1 single, 0 otherwise
household Size (hhsize)	1 for >5,0 otherwise
Household head Educational Level (hheductn)	1 for ≤grade 8,0 otherwise
Parent of household head education (hhfeductn)	1 for < grade 8, 0 otherwise
Employment Status (emptype)	1 if informal employment, 0 otherwise
Adult equivalent per month Income (mhhincom)	1 if less than 263 Birr, 0 otherwise
Access of Basic Service (access)	1 if greater than 1km., 0 otherwise
Health Status (sickm)	1 if sick frequently, 0 otherwise
House ownership (house)	1 if without private house, 0 otherwise
Remittance (remitance)	1 if not received remittance, 0 otherwise

Annex 2: Stratified proportionate sample size by kebele

Arbegnoch Adebabay	=	$\frac{2893}{41058} \times 240 = 16$
Medihanealm Akababi	=	$\frac{3100}{41058} \times 240 =18$
Adebabay Eyesus	=	$\frac{2350}{41058} \times 240 = 14$
Abey Egzi	=	$\frac{2910}{41058} \times 240 = 17$
Gebriel Akababi	=	$\frac{2750}{1058} \times 240 = 16$
Kirkos	=	$\frac{4315}{41058} \times 240 = 25$
Ledeta	=	$\frac{3709}{41058} \times 240 = 22$
Maraki	=	$\frac{4847}{41058} \times 240 = 28$
Azezo Demaza	=	$\frac{3729}{41058} \times 240 = 22$
Azezo Ayermarefeya	=	$\frac{3775}{41058} \times 240 =22$
Abajalie	=	$\frac{3520}{41058} \times 240 = 21$
Mehal Arada	=	$\frac{3210}{41058} \times 240 =19$

The sample sizes were calculated for each urban kebele of Gondar as indicated above.

Annex3: Calorie Contents of Food Items

Consumption Per 100 grams	Energy in Calories
Teff	355
Wheat	340
Maize	344
Sorghum	343
Barley	370
Rice	335
potato	75
Onion	38
Beans, pea & chickpeas	310
Lentil	325
Vegetables	75
Dry pepper	93
Edible Oil	900
Milk	79
butter	700
Sugar	375
Coffee	119
Salt	67

Source: FAO and Ethiopian Health and Nutritional Research Institute
N.B: For more than one item, the average values are taken.

BIOGAS FOR POVERTY REDUCTION AND CLIMATE CHANGE MITIGATION: THE CASE OF ETHIOPIA

Zenebe Gebreegziabher[1]

Abstract

Climate change is expected to have serious economic, social and environmental impacts in Africa in general and sub-Saharan Africa in particular.

Due to relative high cattle number per capita in rural areas Ethiopia is classified among the attractive countries for biogas generation/production. This, an-aerobic digestion of agricultural residues and animal wastes seems to be the one which has high potentialities particularly for rural domestic/household as well as applications, as far as Ethiopia is concerned. Although Ethiopia has currently embarked on dissemination/construction of about a million biogas plants, still application of biogas production and use is in an infant stage. In fact, by helping redress both fuel and soil/land degradation problems in the country, biogas can be viewed as a double-edged sword for poverty reduction and climate change mitigation. However, empirical evidence on the role of innovative biogas application on poverty reduction and climate change mitigation is lacking. In this paper we examine the potential of the biogas innovation for poverty reduction and climate change mitigation, in the context of Ethiopia, using farm dataset referring to 2001 and 2002 production years from stratified sample of 200 farm households in Tigrai, northern Ethiopia.

Keywords: biogas innovation; poverty reduction, climate change mitigation, simulation; Ethiopia

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1. Introduction

Climate change is expected to have serious economic, social and environmental impacts in Africa in general and sub-Saharan Africa in particular. Africa is particularly vulnerable to climate change because of its overdependence on rain-fed agriculture, compounded by factors such as widespread poverty and weak capacity. Hence, climate change is a major threat to sustainable growth and development in Africa, and the achievement of the Millennium Development Goals. The main longer-term impacts of climate change in Africa include: changing rainfall patterns affecting agriculture and reducing food security; worsening water security; decreasing fish resources in large lakes due to rising temperature; shifting vector-borne diseases; rising sea level affecting low-lying coastal areas with large populations; and rising water stress (APF 2007). Therefore, adaptation to and mitigation of climate change appears to be vital to reducing the consequences of climate change on Africa.

On the other hand, strictly speaking, N (nitrogen) and P (phosphorus) deficiencies is believed to be the major biophysical constraints affecting African agriculture and reversing this nutrient (soil-fertility) depletion is vital to poverty alleviation Sanchez *et al*., 1997). In Ethiopia too *land degradation* is the major cause for agricultural stagnation and rural poverty (Wood, 1990; Hagos *et al*., 1999; Hengsdijk *et al*., 2005). Land degradation has various forms including soil erosion.[2] The aspect of land degradation being considered in here is nutrient loss (depletion) because of removal or burning of dung for fuel purposes. Because of the deforestation that has occurred over many years scarcity of fuel wood is a critical problem in Ethiopia. As a result peasants have switched to burning animal dung and crop residues for fuel (Newcombe, 1989; Gebreegziabher, 2001). Such burning of dung which was source of soil humus and fertility is the one that has brought about a progressive decline in land quality and agricultural productivity[3] and eventually instigating rural poverty. Hence, redressing land degradation could contribute to poverty reduction.

Due to relative high cattle number per capita in rural areas Ethiopia is among the attractive countries for biogas generation. Owing to its potential, it is argued that the country could provide more than the subsistence level rural fuel requirements from biogas generation (Parikh, 1983). The recent per capita and average livestock holding (for selected animal types) in Ethiopia is provided in Appendix Table A.4. It

[2] For a further account of the various forms of land degradation better refer the reader see Bojö (1996) pp163-164.

[3] Economic and financial accounts of the reduction in agricultural productivity from lost nutrients associated with use of animal dung for household fuel in Ethiopia can be found in Newcombe (1989), Sutcliffe (1993), and Bojö and Cassells (1995).

also makes much more sense given the areas with severely degraded soils are the ones which support over four-fifth of the country's human population (Shiferaw and Holden, 2000; Gebreegziabher, 2001). In this respect, improvement in resource-use efficiency through technological alternatives like biogas is vital. Biogas was first introduced to Ethiopia in the 1970s (Appendix Table A.2). Appendix Table A.1 provides biogas dissemination in Ethiopia to date. Most of the biogas plants were installed at demonstration centers (Kebede, 1995). Various institutions/agencies were involved in biogas dissemination of which the Ministry of Agriculture (MoA) through its Rural Technology Promotion Centers (RTPC) over the country was one (Appendix Table A.3). The different types (brands) of biogas technologies introduced in the country included the Indian, Chinese and other less known brands including Nepalese model. Amongst which, for the same amount of biogas generated per day, the fixed dome Chinese model was regarded to be less costly than the floating dome Indian model (EESRC, 1995; AFREPREN, 2001). Although Ethiopia has currently embarked on dissemination/construction of about a million biogas plants, still application of biogas production and use is in an infant stage. The high initial investment cost was seen as serious impediment to the dissemination or adoption of biogas technology during that time. More importantly, the fact biogas was largely seen as replacement to fuel wood and kerosene (AFREPREN, 2001) and its role in redressing land degradation (i.e., poverty reduction) and climate change mitigation was not realized might have resulted in the very limited attention for this subject.

Agricultural emission related with methane emission from livestock is the second most important emitter in the African continent. It accounts for about 96 percent of the aggregate emission for Benin and 80 percent for Ethiopia (UNFCCC, 2005). In addition, methane, which is released from livestock, is 22 times more damaging than carbon dioxide. By turning human and animal waste into a mixture of methane and carbon dioxide that can be used for lighting and cooking, biogas helps reduce methane's more damaging global warming effects, by directly contributing to climate change mitigation and poverty reduction. In fact, by helping redress both fuel and soil/land degradation problems in the country, biogas can be viewed have a double-dividend, i.e., poverty reduction and climate change mitigation. However, empirical evidence on the role of innovative biogas application on poverty reduction and climate change mitigation is lacking. In this paper we examine the potential of the biogas innovation for poverty reduction and climate change mitigation, in the context of Ethiopia, using farm dataset referring to 2002 (G.C.) production year from stratified sample of 200 farm households in Tigrai, northern Ethiopia.

The remaining of the paper is organized as follows. In the next section we present a review of biogas, poverty reduction and climate change mitigation. Section 3 provides conceptual model/framework employed in the analysis; simulation setup and data in section 4, results and discussion in section 5; conclusions will follow.

1. Biogas, poverty reduction, and climate change mitigation: Review

The early history of methane gas produced by fermentation goes to the beginning of 1st century A.D. The appearance of flickering lights emerging from below the surface of swamps was noted by Plinius (van Brakel, 1980). However, a more recognizable scientific works in this respect started in the 17th century.

Generally, technological options for the use of biogas as energy source in rural areas are two: one at household or family level and another at village or community level (Parikh, 1983). Meaning, there are village size or community biogas plants and family size or household plants. Nevertheless, it should also be noted that there are large-scale and intermediate scale digesters used for agro-industrial applications such as in food factories, wineries, etc and for urban applications such as electric power generation (Daxiong *et al*., 1990; Heavner and Churchill, 2002).

Globally speaking China, India, and Nepal are the most popular countries for dissemination of biogas. There are about five million biogas digesters in China (AFREPREN 2001). Biogas in China is used by about 25 million people, for cooking and lighting for 8-10 months a year. Many rural households are equipped with both biogas stoves and improved cooking stoves. With the latter type, the peasants burn straw and wood as usual during the winter months, for cooking and heating (i.e., with another source of energy for summer months). Besides to household heating and cooking, biogas in China is used for poultry hatching, tea roasting, and grain and fruit storage. Moreover, the slurry is also used as fertilizer for fish farming and for pig feed which showed good results in semi-intensive production systems (Steinfeld *et al*., 1998). Aggregate gas production of all household digesters in China totals about 2,000 million m^3 biogas per year. In southern China, the total gas yield of family size digesters averages 300 m^3 per year (over 8 months); whereas in the north, production is 200 m^3 biogas per year or less depending on ambient temperatures.

Biogas technology is particularly useful system in the rural livelihoods, and can fulfill several end uses. The gas is useful as a fuel substitute for firewood, dung, agricultural residues, petrol, diesel, and electricity, depending on the nature of the task, and local supply conditions and constraints (Lichtman, 1983), thus supplying energy for cooking and lighting. In fact, in this respect, biogas technology may have the potential to short-circuit the 'energy transition' from biomass to 'modern' fuels

(Leach 1987). Biogas systems also provide a residue organic waste, after anaerobic digestion that has superior nutrient qualities over the usual organic fertilizer, cattle dung, as it is in the form of ammonia (Sasse et al, 1991). Anaerobic digesters also function as a waste disposal system, particularly for human waste, and can, therefore, prevent potential sources of environmental contamination and the spread of pathogens (Lichtman, 1983). For instance, in an IFAD biogas project in China, each household involved in the project built its own plant to channel waste from the domestic toilet and nearby shelters for animals, usually pigs, into a sealed tank. The waste ferments and is naturally converted into gas and compost. Hence, living conditions and the environment have improved as a result of the project. Forests are protected thereby reducing greenhouse gas emissions that would have resulted through deforestation. Moreover, a large amount of straw, previously burned, is now put into biogas tanks to ferment. This further reduces air pollution from smoke and helps produce high-quality organic fertilizer, rendering the project result in better sanitary conditions in the home. With more time to spend on farming improving crops, farmers in Fada, one of the village in the project area, increased tea production from 400 to 2,500 kilograms a day over a five-year period. Average income in the village has quadrupled to just over a dollar per day. (IFAD, http://www.ifad.org/climate/perspectives/biogas.htm)

Despite that considerable progress have been made in reducing poverty in some parts of the world – notably in East Asia – over the past couple of decades there are still about 1.4 billion people living on less than US$1.25 a day, and close to 1 billion people suffering from hunger (IFAD, 2010). It is also believed that not less than 70 per cent of the world's very poor people are rural. Among others declining agricultural productivity due deteriorating natural resource base such land degradation have contributed to this rural poverty. In this regard, land degradation is a serious global concern. It affects some two-thirds of worlds' agricultural land resulting in agricultural productivity decline (UNDP, 2002). It results in income loss and food insecurity, threatening livelihoods. Land degradation has various facets. The focus in here is on the soil fertility (nutrient) depletion aspect of land degradation.The burning (removal) of dung and crop residues which were previously sources of soil humus and fertility has resulted in a progressive decline in land quality and agricultural productivity. In the context of Ethiopia, this has increased farmers' vulnerability to shocks, food insecurity and poverty (Amsalu, 2006). Scherr (2000) identifies soil erosion, soil fertility (nutrient) depletion, and de-vegetation, loss of biodiversity, soil compaction, acidification, and watershed degradation as common problems of land degradation in the densely-populated marginal developing regions. She argues that, among others, improving the productivity of poor people's natural resources assets as the main strategy to simultaneously address poverty and environmental (land) degradation. In addition, Scherr also argues that more research is needed to explore and understand the agriculture-environment-poverty nexus. Scherr further suggests that conditions affecting the adoption of resource-conserving technologies, local endowments as well as local institutions that are supportive to the poor are key factors that determine the interactions between poverty and environment.

Climate change is a real threat to our planet. Climate change is a major threat to sustainable growth and development in Africa, and the achievement of the Millennium Development Goals (AFP, 2007). Two key messages that stand out in the climate change discussion are that developed countries must take the lead in combating climate change and that mitigation will be neither effective nor efficient without abatement (mitigation) efforts in developing countries (World Bank, 2010). Although the Africa region has the lowest average per capita emission (UNFCC, 2005), it is particularly vulnerable to climate change because of its overdependence on rain-fed agriculture, compounded by factors such as widespread poverty and weak capacity to adapt. Mitigation actions are necessary not only to enhance sustainable development but also prevent the continent from becoming a major emitter. Agricultural emission related with methane emission from livestock is the second most important emitter in the continent. It accounts for about 96 percent of the aggregate emission for Benin 80 percent for Ethiopia (Ibid). It appears that Africa should take adequate care of mitigating emissions from livestock systems. The most important ways to do this include better feed management, using more productive livestock breeds (or shifting species), and manure management (Herrero and Thornton, 2009). But, more important, developing countries have high potential for least-cost way of mitigating climate change including methane capture through biogas.

Two issues stand out quite apparent from the foregoing review. Firstly, that land degradation, the diversion of dung and crop residues from their high value uses in agriculture for fuel purposes, is a major concern which is undermining the livelihoods of many rural people and that technological alternatives that improve the productivity of poor people’s natural resources assets and simultaneously address poverty and environmental (land) degradation could be thought as a means to deterring the environmental (land) degradation and redressing the problem. Secondly, although the Africa region has the lowest average per capita emission, mitigation actions, particularly mitigating emissions from livestock systems, are necessary not only to enhance sustainable development but also prevent the continent from becoming a major emitter.

2. Conceptual framework

The fundamental questions involved in assessing or evaluating the potential of biogas innovation in poverty reduction (i.e., through reversing land degradation) and climate change are: one, how and to what extent does the biogas innovation contribute to improvement in soil (land) quality and productivity? Two, understanding the channels through which and to what extent does the biogas innovation contribute to climate change mitigation? Therefore, the immediate logical step would be assessing its impacts in terms of enhancing agricultural productivity and farm returns as well as in terms of reductions in Greenhouse Gas (GHG) emissions. This section, therefore, outlines the conceptual framework or analytical methods employed to analyse these two effects of biogas.

3.1 Poverty reduction potential

Now suppose that adoption of a biogas innovation results in improvement in soil fertility and productivity which eventually contributes to poverty reduction (see Section 4.1 for the details of the link between biogas innovation and poverty reduction). As regards to measuring such reduction poverty, or poverty for that matter, the literature often distinguishes between absolute and relative poverty. Absolute poverty refers to a set standard which is consistent over time and between countries. An example of an absolute measurement would be the percentage of the population eating less food than is required to sustain the human body, i.e., approximately 2000 to 2500 calorie per day per adult equivalent (Reyes, 2007). Relative poverty, in contrast, views poverty as socially defined and dependent on social context. One relative measurement would be to compare the total wealth of the poorest one-third of the population with the total wealth of richest 1% of the population (Ibid).

Note that both absolute and relative poverty measures are usually based on a person's yearly income and frequently take no account of total wealth. Therefore, some people argue that this ignores a key component of economic well-being. The World Bank defines poverty in absolute terms. The bank defines extreme poverty as living on less than US $1 per day PPP (Purchasing Power Parity) adjusted, and moderate poverty as less than $2 a day (World Bank, 1990; Chen and Ravallion, 2001).

In addition, the literature also distinguishes among various poverty indices as headcount index, poverty gap index, poverty severity index, Sen index, Sen-Shorrocks-Thon index and Watts index (Foster et al, 1984; World Bank, 2005). The headcount index is the popular one as it is easy to understand and measure.

However, it fails to indicate how poor the poor are. Therefore, for the purpose of this study we apply the poverty gap index and poverty severity index.

Poverty Gap Index: It measures the mean distance below the poverty line as a proportion of the poverty line where the mean is taken over the whole population, counting the non-poor as having zero poverty gap (World Bank, 2005). The Poverty Gap Index measures the depth of poverty in a country or region, based on the aggregate poverty deficit of the poor relative to the poverty line. As mentioned earlier, because it is not sensitive to changes in the status of those already below the poverty line, the Head Count Index is inadequate in assessing the impact of specific policies on the poor. The *Poverty Gap Index* (P_1), on the other hand, increases with the distance of the poor below the poverty line, and thus gives a good indication of the depth of poverty. A decline in the *Poverty Gap Index*, hence, reflects an improvement in the current situation.

The poverty gap index which is related also to the headcount index is computed as follows (World Bank, 2005):

$$P_1 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{G_i}{z}\right), G_i = (z - y_i).I(y_i \leq z). \qquad (1)$$

where the poverty gap of individual *i* (G_i) is the difference between the poverty line (z) and income or consumption (denoted by y_i) for those who are poor (the non-poor have a poverty gap of zero). The I(.) on the right-hand-side of equation (1), which is a multiplying term defining G_i, is an indicator function that equals 1 if the bracketed expression is true, and 0 otherwise. N is the total population (i.e., sample size in our case). Note also that in our specification as in equation (1) an individual (i.e., the household) is considered as non-poor only when her/his income or consumption is strictly above the poverty line, i.e., $y_i > z$.

Poverty Severity Index: The *poverty severity index* (P2) or squared *poverty gap* averages the squares of the poverty gaps relative to the poverty line. It is one of the Foster-Greer-Thorbecke (FGT) class of poverty measures that may be written in its general form as (Foster et al, 1984; World Bank, 2005):

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{G_i}{z}\right)^\alpha \qquad (2)$$

where *N* is the size of the sample, *z* is the poverty line, G_i is the poverty gap of individual or household *i* as defined in above and α is a parameter. Note that when α is larger the index puts more weight on the position of the poorest. But, in our case, because we are considering the *poverty severity* which is the square of *poverty gap*, $\alpha = 2$.

3.2 Global warming mitigation potential

The global warming mitigation potential (GMP) and carbon credit from the biogas plants can be calculated at four levels: (a) a family size biogas plant (GMP_Family), (b) the existing biogas plants (GMP_Exist), (c) target number of biogas plants as set by the current government plan (GMP_Target), and (d) potential number of biogas plants when all the collectible cattle dung is used for biogas production (GMP_Potential). The GMP and carbon credit from a family size biogas plant (GMP_Family) was calculated considering five factors as shown in the following equation (Schlesinger 1999; Lal, 2004; Pathak and Wassmann, 2007).

GMP *(*CO2e[4]*)* = **Reduction** in CO2 emission from kerosene and
firewood savings + **Reduction** in CH4 emission from firewood saving
+ **Reduction** in CO2 emission from N, P and K fertilizer production
+ **Reduction** in N2O emission from N fertilizer application
– **Leakage** of CH4 from biogas digester (3)

A simplified scheme of various calculations, the inputs used, driving variables and resultant outputs is shown in Table 8 and various coefficients used are listed in Appendix Table 5. To start with, biogas generation by a family size biogas plant (3 m^3 capacity), operated with dung produced by five cattle, i.e., the size of cattle commonly reared the average household (Table 4), was calculated using the relationship of 0.5 m3 biogas kg^{-1} dry dung (Khendelwal and Mahdi 1986). In context of rural Ethiopia, *injera* baking is largest consumer of energy. It accounts for over two-thirds of the total domestic fuel consumption, with the remaining going for other cooking and lighting (Gebreegziabher, 2007). Therefore, it was assumed that 80% of generated biogas would be used for replacing firewood and 20% for replacing kerosene as fuel. Kerosene and firewood equivalents of the produced biogas were then calculated using the calorific values of these fuels (Appendix Table 5). This implied that a family size biogas plant would save the calculated quantities of kerosene and firewood, which would otherwise emit GHG to the atmosphere upon burning as fuel. Carbon dioxide emissions from burning of dung would generate similar amount of biogas spent slurry containing 1.4% N, 0.5% P, and 0.8% K, on dry weight basis (Subrian et al., 2000; Tandon and Roy, 2004). Substitution of chemical fertilizer with spent slurry

[4] CO2e=CO2 equivalent.

reduces CO_2 emission, which would emit for production of fertilizer. Hence, emission of CO_2 was calculated using equation (3), with all these issues in mind.

4. Simulation setup and data

4.1 Simulation setup

In the presence of longitudinal field or plot level monitoring data on the dynamics of soil quality, it turns out to including the soil quality attribute into the regression model to see how output changes over time with changes in soil quality. Nonetheless, one can hardly find such type of data in developing country settings. Nor do we have observations on biogas innovation. Therefore, we simulate the relevant biogas technology from experiences elsewhere. However, as explained earlier, studies on effect of use of slurry on yield are extremely scanty. In addition, it is not obvious the mechanism or channels through which it affects production. To our knowledge Marchaim (1992) is the only one that tried to documents evidences on the effect of use of slurry (effluent) on yield. Evidences are that use of effluent for soil fertility maintenance increases yields of various crops by 11 to 20% (Marchaim, 1992). Hence, this level of yield increase experienced elsewhere was assumed to hold in our case. In fact, some have found that the use of compost alone increases yield by about 100 percent for certain crops and by up to 5o percent for others (Edwards, 2008). Hence, we believe that assuming these figures to apply or hold for Ethiopia is reasonable if not low. Three alternative levels of productivity improvements, i.e., 11, 16 and 20 percent yield increase resulting from biogas innovation, that is, the use of the slurry as fertilizer were considered in the simulation. Table 1 below provides an overview of the relationship between digester size, cattle requirement and end users equivalent of gas output. To begin with, as could also be clear from the table, it appears that two heads of cattle is taken as the minimum requirement for a family size-biogas plant (AFREPREN, 2001). However, the cattle requirement shouldn't be restrictive given that dung can be collected and straw can also be used as feed stock for biogas generation.

Financial benefits of biogas innovation envisaged were two: benefit from use of slurry (effluent) for soil fertility maintenance and benefit from savings on kerosene expenditure. Benefit from use of slurry (effluent) for soil fertility maintenance was numerically computed for each of the sample farm (household). The difference between actual yield and simulated yield with respect to the crops considered was regarded as productivity gains from using or adopting biogas innovation and used in the benefit computation. Crop output prices (and exchange rate) during the survey period in the dataset were used in the computation of benefit. Moreover, the annual cash outlay on kerosene by respective sample farm households was taken as savings on kerosene expenditure and added to the benefit stream in the analysis applied to all the samples.

Table 1: Relationship between digester size, cattle requirement and end users equivalent of fuel/gas output

Digester size/capacity (m^3 gas production/day)	Number of cattle required	Daily requirement of fresh dung (kg)	End use equivalent (Cooking of number of persons)
2	4 to 5	35 to 50	5 - 8
3	6 to 8	50 to 75	8 - 12
4	7 to 9	80 to 90	12 - 16
6	10 to 12	95 to 120	16 - 20
8	12 to 15	115 to 150	22 - 26
10	16 to 20	150 to 200	28 - 32

Source: Krishna (1988) and Hailu and Tesfay (1994)

Biogas digester types (brands) important for Ethiopia are floating dome (Indian model) and the fixed Chinese (or *Deenbandhu*) model. Initial investment cost of biogas plant varies between Birr 4,600 to 6,100 (BTSDT, 2001) depending on the size (capacity) of the digester. A family-size biogas plant of $2m^3$ gas per day capacity was considered in our analysis.

We focus on poverty measures as one of the aims in here is to analyze the role biogas in poverty reduction through enhancing productivity and income of farm households.[5] We used the US$ 2 per day international poverty line for moderate poverty in our analysis.

Continuous loading fermentation process is assumed. Under the continuous loading fermentation process the normal digestion and gas production begin after a certain period of time from the initial feeding. Feed stock is then fed continuously into the digester every day and effluent is discharged in the same amount of influent, simultaneously. By such process constant fermentation and uniform gas productions could be achieved. Moreover, the control is also easy. Then the household uses the biogas output to meet its fuel needs and the byproduct or slurry to be applied to crop fields for soil fertility maintenance. We assume that the biogas output will be sufficient to meet the household's fuel needs including *injera* baking, other cooking and lighting. We consider the biogas digester plant is centrally located near the stable/homestead at about 15 m distance from the housing unit and farmer's plots are located within certain radius from stable (homestead).

[5] Detail analysis of economic viability of biogas can be found in Gebreegziabher (2007)

4.2 Study area and data

The dataset used in this paper come from a stratified sample of peasant farmers in northern Ethiopia. A two period (two production year) data from 200 cross-sections of peasant households was obtained. The data set refers to 2002 (G.C.) production year and farmers in the sample are located particularly in *Enderta* and *Hintalo-Wajerat* districts of Tigrai, northern Ethiopia.

Mixed crop-livestock farming is the dominant system in the area. Crops grown by peasant farmers include lentils, vetch, linseed, and vegetables with barley, wheat, *teff*, and sorghum. Most of this peasant agriculture or crop production is practiced under rain-fed condition. Table 2 provides the cropping pattern in the study area. Barely, wheat, *teff* and legumes are the most important crops in the area in order of importance in terms of the number of farmers involved, i.e., the percentage of farm household growing the crops. Considerably lesser proportion farmers are found to be involved in growing oil crops, vegetables, and sorghum and millet.

Table 2: Cropping pattern: percent of farm households growing crops

Crop type	Enderta	Adigudem	Total
Teff	63.5	65.4	64.4
Wheat	71.0	64.4	67.7
Barley	78.5	82.7	80.6
Sorghum and finger millet	6.0	22.3	14.2
Legumes	42.5	39.1	40.8
Oil crops	7.5	10.9	9.2
Vegetables	9.5	4.9	7.2

Source: Woldehanna (2000)

Table 3 also presents share of land and inputs allocation per *tsimdi* by crop type of an average farm household. Barely, wheat, and *teff* are the most important crops in the study area in terms share of land. The three crops account for over two-thirds of the cultivated land area of the average household. *Teff* is the next most important crop in terms of labor intensity next to vegetables followed by sorghum and millet. However, considering variables farm inputs (fertilizer, seed, pesticides, etc) utilization, wheat, barley, and vegetables are the most important crops in the study area in order of importance.

Table 3: Share of land and inputs allocation per *tsimdi* by crop type of an average farm household (1 *tsimis*=one-fourth hectare)

Crop type	Share of land	Labor hour/ tsimdi	Var. inputs Birr/tsimdi
Teff	0.197	167.94	34.70
Wheat	0.250	76.42	87.46
Barley	0.364	71.05	77.13
Sorghum and finger millet	0.049	83.26	11.49
Legumes	0.110	70.64	48.24
Oil crops	0.018	69.76	29.46
Vegetables	0.010	185.24	61.89

Source: Woldehanna (2000)

Summary statistics of variables considered in the estimation of revenue from biogas installation provided Table 4. As could be clear from the table, output of the three crops considered ranged between 2.8 and 5.7 quintals. Labor input into the three crops also ranged between 174 to 307 hours. Relatively larger size of land was allotted to wheat followed by barley and *teff*.

Table 4: Summary statistics of farm dataset used in the simulation (n=200)

Variable name	Mean	Std. Dev.	Min	Max
Total yield in kg (barley)	436.03	510.97	50	3900
Total yield in kg (*teff*)	276.88	307.88	50	2100
Total yield in kg (wheat)	574.42	637.17	50	3800
Labor input in hours (barley)	174.49	166.44	24	1196
Labor input in hours (*teff*)	306.59	283.48	92	1608
Labor input in hours (wheat)	194.29	201.60	32	1920
Land in *tsmdi* (barley)	2.492	2.05	1	13
Land in *tsmdi* (*teff*)	1.909	1.83	1	8
Land in *tsmdi* (wheat)	2.517	2.51	1	20
Variable farm inputs in birr (barley)	234.23	282.56	30	2080
Variable farm inputs in birr (*teff*)	46.60	59.77	6	375
Variable farm inputs in birr (wheat)	219.61	281.56	24	2989
Capital farm input in birr (total)	1696.18	1528.25	0	9700
Number of cattle	5.421	4.98	0	32

Source: Author's own calculations from the dataset.

Table 5 below also provides the descriptive statistics in relation to expenditure, quantity consumed and time spent collecting fuel of sample households. Food expenditure accounts for three-fourths of the household's total expenditure. The mean total expenditure in the study area, in US $/ day, is 1.46, which is below the threshold level for moderate poverty, i.e., 2 US$/ day. An average household spends about 266 hours per year collecting dung and fuelwood. Dung appears to be the most important fuel/energy source for households in the study area. However, it could be that most of the dung consumed is coming from own source instead of being collected that the average time spent collecting dung is lesser.

Table 5: Descriptive statistics expenditure, quantity consumed and time spent collecting fuel of sample households (n=199)

Variable name	Mean	Std. Dev.	Min	Max
Food expenditure (Birr/annum)	3379.13	1617.21	616	12100
Non-food expenditure (Birr/annum)	1068.90	987.39	43	9504
Total expenditure (Birr/annum)	4448.03	2196.54	659	16031
Total expenditure (US$/day)	1.46	0.72	0.22	5.27
Quantity consumed dung in kg per year	1364.59	790.71	0	3951.36
Quantity consumed wood in kg per year	624.26	743.99	0	4129.92
Quantity consumed kerosene in lit per year	13.30	5.87	0	48
Kerosene expenditure in birr per year	51.57	25.94	0	216
Time spent collecting dung in hours per year	109.11	180.95	0	973
Time spent collecting wood in hour per year	157.08	240.07	0	1498

Source: Author's own calculations from the dataset.

Some of these biogas plants were used both for lighting and other cooking with small stoves fitted to them. *Injera* baking is an essential end use in the context of Ethiopia as far as household fuel consumption is considered and accounts for over half of the household's fuel consumption, both in urban and rural areas. However, little attention was given to include i*njera* baking in the biogas plants so far demonstrated. In fact, research work in this respect has shown that there exists the potential for use of biogas for *injera* baking, which in turn reinforces the possibility for integrating the various fuel end uses of household lighting, other cooking and *injera* baking into one biogas plant.

3. Results and discussion

Dung turns out to be the dominant fuel source for households in the study area. Moreover, no evidence of manure use of dung was found in the dataset suggestive of the fact that most of the dung resource in the area being directly burned for fuel, with nearly nothing left for soil fertility maintenance. Hence, it can safely be argued that the current production technology is representative of the conventional practice with low output level due low level of soil fertility maintenance. As could be evident, with biogas innovation, farmers will be operating on a higher production frontier as farmers will be able to replenish most of the nutrients that would otherwise be lost applying the conventional practice, i.e., direct burning of dung. Simulation results showed that, on average, biogas innovation results in crop-specific potential gain of between 30 and 87 kg in yield terms depending on the crop type and level of yield increase being considered (see Table 6).

Benefit streams considered were productivity enhancement benefit from use of slurry (effluent) for soil fertility maintenance and benefit from savings on kerosene expenditure. The productivity enhancement benefits of biogas from use of slurry (effluent) for soil fertility maintenance were computed on the basis of individual farm household data. The simulation could be applied to all crops that needed nitrogen. However, it was simplified to Teff, Wheat and Barley, which cover about 80 percent of the arable land. Simulated increase in total yield on the basis of actual yield for each of these three different crops was considered as productivity gain from using or adopting a biogas innovation. Then, these results were used in the determination of benefit streams for respective farms (households). Simulated yield increases on the basis of actual yield showed that, on average, biogas innovation results in crop-specific potential gain of between 46 and 114 Birr per farm (household), in value terms (see Table 6).

Table 6: Summary of simulated yield increase in kg and revenue in Birr from biogas installation for alternative levels of productivity improvement by crop

Biogas benefit scenario	Mean simulated yield/revenue increase by crop		
	Barley	Teff	Wheat
Simulated yield increase in kg			
(i) 11% increase in yield	48	30	42
(ii) 16% increase in yield	70	44	61
(iii) 20% increase in yield	87	55	76
Simulated revenue increase in Birr			
(i) 11% increase in yield	60	46	63
(ii) 16% increase in yield	87	66	91
(iii) 20% increase in yield	109	83	114

A simple application of poverty indices, i.e., poverty gap index and poverty severity index was used for linking biogas to poverty reduction. Through supplying both energy and manure we found that biogas results in poverty reduction. For example, considering the poverty gap index, we found that poverty would be reduced by a range of between six and ten percentage points depending on the biogas financial benefit scenario. Moreover, considering the poverty severity index, we found that poverty would be reduced by a range of between five and eight percentage points depending on the biogas financial benefit scenario (see Table 7). This would be equivalent to bring the study region or Ethiopia for that matter from a 'high' level of poverty – a poverty gap index equal to .65 – to a 'relatively lower' level - a poverty gap index of .55, in the case of biogas benefit scenario (iii). Such drop in the poverty rate turns out to be quite substantial. Amid simplifying assumption, it turns out that dissemination of biogas is compatible with poverty reduction strategy of the country.

Table 7: Poverty indices calculation results for alternative biogas financial benefit scenarios (n=199)

	Initial	**Biogas benefit scenario**		
	(P_0)	**(i)**	**(ii)**	**(iii)**
Poverty gap index	0.646	0.582	0.563	0.549
Change in poverty gap index		0.064	0.083	0.097
Poverty severity index	0.640	0.586	0.570	0.556
Change in poverty severity index		0.054	0.070	0.084

Besides supplying energy and manure, biogas technology provides an excellent opportunity for mitigation of GHG emission and reducing global warming through substituting firewood for cooking, kerosene for lighting and cooking and chemical fertilizers. In particular, two dimensions of global warming/climate change mitigation potential of biogas are examined. First, we calculate the global warming mitigation potential and the resulting carbon credit earning of a family size biogas plant in Ethiopia. Second, we assess the GMP of target biogas plants at the study are and country level. On average, a family size biogas plant substitutes 13.3 l of kerosene, 624.26 kg firewood and 1,364.59 kg cattle dung cake as fuels which will, respectively, reduce emissions of NOx, SO_2, CO and volatile organic compounds to the atmosphere by 16.4, 11.3, 987.0 and 69.7 kg $year^{-1}$ (Pathak et al., 2008). The GMP of a family size biogas plant is found to be 9.7 t CO_2 equiv. $year^{-1}$ (see Table 8). With the current price of US \$9 $t^{-1}CO_2$ equiv. (Gebreegziabher and Mekonnen, 2010), it implies carbon credit of US \$87 $year^{-1}$ could be earned from such reduction in greenhouse gas emission if linked to the Clean Development Mechanism (CDM). The Government of Ethiopia has a target of installing 5 million biogas plants. This target has a GMP of 50 Mt CO_2 equiv. $year^{-1}$ and US \$125 million in carbon credit under the CDM. Such a reduction in global warming should encourage policy makers to promote biogas technology to combat climate change and the integration of carbon revenues will help the farmers to develop biogas as a profitable activity.

Table 8: Annual GHG mitigation potential (GMP) and carbon credit from a family size biogas plant for Ethiopia

Parameter	Value
No. of cattle	4
Total dung (kg dry wt.)	4,400
Biogas production (m^3)	2,200
Kerosene saving (lt)	316
GWP for kerosene (kg CO2 equi)	762
Firewood savings (kg)	5,535
GWP for wood (kg CO2 equi)	10,571
Slurry produced (kg C)	1,725
Fertilizer N equivalent (kg)	62
Fertilizer P equivalent (kg)	22
Fertilizer K equivalent (kg)	35
GWP for fertilizer (kg CO2 equi)	302
CH4 leakage per plant (kg)	94
GWP of leaked CH4 (kg CO2 equiv.)	1,968
GMP (kg CO2 equiv.)	9,667
Price of carbon credit (US \$ t^{-1} CO2 equiv.)	9
Carbon credit per plant (US $)	87

4. Conclusions

By way of reviewing biogas technologies and role of biogas in rural livelihoods; this paper developed a conceptual framework to assess the potential of biogas technology for poverty reduction and climate change mitigation. We examine the potential for productivity improvements and hence poverty reduction of biogas by simulating the relevant technology from experiences elsewhere. We consider the US$ 2 per day international poverty line for moderate poverty in calculating the poverty indices. Moreover, we also examine its global warming/climate change mitigation potential. The following conclusions can be drawn from the foregoing discussion.

Biogas innovation appears to be an appropriate technology, both from sustainability and resource use efficiency considerations, for countries with land degradation instigated rural poverty problem like Ethiopia. It meets fuel demand of farm households. It enables farmers to replenish most of the nutrients that would otherwise be lost applying the conventional practice. Indeed biogas technology is a double-edged sword with considerable potential for reducing poverty while at the same time contributing to climate change mitigations. We found that biogas reduce poverty by up to ten percentage points depending on the biogas financial benefit and poverty measure used. We also found that biogas technology provides an excellent opportunity for mitigation of greenhouse gas (GHG) emission and reducing global warming through substituting firewood for cooking, kerosene for lighting and cooking and use of chemical fertilizers. It also makes much more sense given the high cattle number in rural areas of Ethiopia, both in terms of per capita and average holdings. Despite such potentialities biogas dissemination in the country is at its infant (demonstration) stage. But, more important, developing countries like Ethiopia have high potential for least-cost way of mitigating climate change including methane capture through biogas and they need to be compensated for this.

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Appendices

Table A.1: Biogas dissemination in Ethiopia by region and type (brand) of digester

Region	Number of digesters	Type of digester				
		Indian floating	Chinese	Camaratec	Deenhandhu	others
Tigrai	16	13		3		
Afar	1	1				
Amhara	70	64		1	3	2
Oromiya	165	92	5	24	7	37
Somalie	3	3				
Benishangul	3	1				2
SNNP*	72	67	1	2	2	
Gambela	1	1				
Harari	5	4		1		
Addis ababa	18	12		1	2	3
Dire Dawa	4	3			1	
Country total	358	261	6	32	15	44

*SNNP is Southern Nations Nationalities Peoples' region

Source: BTSDT (2001)

Table A.2: Biogas digesters in Ethiopia by region and year of construction

Region	Number of digesters	Year of construction				
		1970-4	1975-9	1980-4	1985-9	1990-3
Tigrai	16	4			10	2
Afar	1					
Amhara	70		5	7	51	7
Oromiya	165	13	44	18	48	42
Somalie	3				3	
Benishangul	3				1	2
SNNP*	72	2	15	21	32	2
Gambela	1				1	
Harari	5				5	
Addis ababa	18	2	2	5	2	7
Dire Dawa	4					4
Country total	358	21	66	51	154	66

Source: BTSDT (2001)

Table A.3: Biogas dissemination in Ethiopia by region and institutions involved

Region	Number of digesters	Institutions involved				
		EREDPC	MoA (RTPC)	R.E. Bureau	NGOs	Others
Tigrai	16	2	8	1	5	
Afar	1			1		
Amhara	70	5	54	1	10	
Oromiya	165	39	48		43	35
Somalie	3			3		
Benishangul	3			1		2
SNNP*	72	8	60		4	
Gambela	1			1		
Harari	5	2	1	2		
Addis ababa	18	12			4	2
Dire Dawa	4	1		3		
Country total	358	69	171	13	66	39

*SNNP is Southern Nations Nationalities Peoples' region
Source: BTSDT (2001)

Table A.4: Per capita and average holdings of selected livestock in Ethiopia in 2001/02 by region

Region	Per capita holding				Average holding			
	Cattl e	Sheep	Goats	Poultry	Cattle	Sheep	Goats	Poultry
Tigrai	0.78	0.20	0.52	1.20	3.66	0.94	2.44	5.66
Afar	2.71	1.22	2.35	0.41	12.65	5.72	10.96	1.90
Amhara	0.72	0.36	0.26	0.91	3.25	1.64	1.19	4.13
Oromiya	0.83	0.22	0.19	0.68	4.13	1.07	0.96	3.37
Somali	0.88	0.77	0.96	0.22	4.80	4.18	5.25	1.21
Ben Gumuz	0.49	0.09	0.34	1.54	2.21	0.41	1.52	6.99
SNNP	0.72	0.26	0.22	0.66	3.29	1.18	0.99	3.00
Gambella	0.83	0.31	0.33	1.58	3.54	1.30	1.43	6.73
Harari	0.49	0.07	0.27	0.43	2.35	0.35	1.27	2.05
Addis Ababa	0.84	0.16	0.00	0.84	4.06	0.76	0.00	4.07
Dire Dawa	0.63	0.36	1.06	0.52	3.27	1.87	5.45	2.65
Country overall	**0.77**	**0.27**	**0.26**	**0.78**	**3.65**	**1.29**	**1.21**	**3.67**

Source: CACC (2003a, b)

Table A.5: Conversion factors used for calculation of GHG mitigating potential of biogas plant

Parameter	Conversion factor
CO2 emission from kerosene burning (kg l^{-1})	2.41
CO2 emission from firewood burning (kg kg^{-1})	1.83
CH4 emission from firewood burning (g kg^{-1})	3.9
Calorific value of biogas (kcal l^{-1})	4.81
Calorific value of CH4 (kcal l^{-1})	8.0
Density of methane (kg m^{-3})	0.71
Calorific value of kerosene (kcal l^{-1})	8,365
Calorific value of firewood (kcal kg^{-1})	3,824
Kerosene equivalent of biogas (l m^{-3})	0.58
Density of kerosene (kg l^{-1})	0.81
Firewood equivalent of biogas (kg m^{-3})	1.26
Annual dung production per cattle (kg dry wt.)	1,100
Biogas production from cattle dung (m3 kg^{-1} dry wt.)	0.5
Methane content in biogas (%)	60
C content in slurry (kg kg^{-1} dry wt.)	0.4
N content in slurry (kg kg^{-1} dry wt.)	0.014
P content in slurry (kg kg^{-1} dry wt.)	0.011
K content in slurry (kg kg^{-1} dry wt.)	0.008
CO2 emission for N fertilizer production (kg kg^{-1})	1.3
CO2 emission for P fertilizer production (kg kg^{-1})	0.2
CO2 emission for K fertilizer production (kg kg^{-1})	0.2
N2O-N emission from N fertilizer application (kg kg^{-1})	0.07
Methane leakage from biogas plants (% of production)	10
GWP of CO2 (kg CO2 equiv. kg^{-1})	1
GWP of CH4 (kg CO2 equiv. kg−1)	21
GWP of N2O (kg CO2 equiv. kg−1)	310
Carbon credit (US $ t−1 CO2 equiv.)	10

Source: Pathak et al (2008)

CONSUMPTION-BASED MEASURES AND ANALYSIS OF URBAN POVERTY: THE CASE OF MAICHEW, SOUTHERN TIGRAI: ETHIOPIA

Menasbo Gebru[1], Fredu Nega[2], and Alemat Hagos[3]

Abstract

This study examines the extent and vulnerability to poverty of households of urban residents in Maichew, southern Tigray Regional State, Ethiopia. It tries to look at the welfare status at household level through different micro-analytical techniques like Foster, Greer and Thorbecke (FGT), OLS, 3FGLS and Gini coefficient. Using the Cost of Basic Needs approach, total poverty line of the study area is Birr 251 per month per adult. Poverty profile of the town reveals that 31.70% of households are below poverty line. Multivariate analysis results illustrate that male headed households, educational level of the household head and spouse have positive impact on welfare while family size, square age of household head, divorced and widowed headed households have negative effect to welfare. Tobit model described factors affecting poverty severity of the poor households. Accordingly, pensioner headship, family size and age square of household head aggravate the probability of falling to poverty severity. However, being petty trade household head, household head's education, ownership of durable property reduce the probability of falling to poverty severity. Using 3FGLS, the mean probability of vulnerability to poverty is 0.4 which is poverty head count index next period and it ranges from 0.041 to 0.89. Gini coefficient indicates 0.49 of total inequality. Factor decomposition of inequality typifies that property index and social transition of household head take the greater share of 14.6% and 12.4% policy implication of the results respectively.

Key Words: Consumption, Poverty, Vulnerability to poverty, Inequality, urban Maichew.

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1. Introduction

Poverty still possesses a leading agenda in most of the developing world. Empirical studies demonstrate that numerous people in cities in developing countries live in absolute poverty and this number increases all the time. Poverty in the urban areas differs from poverty in rural areas in several ways. The most important and most obvious difference is that a person who is poor in urban area is totally reliant on cash for survival; food, fuel, water, and housing are often more expensive in urban than in rural areas particularly in sub- Saharan Africa (Hagos and Holden, 2000; Baker and Schuler, 2004).

Unemployment and underemployment are major concerns for many urban developing economies. According to Masika et al (1997), it is widely recognized that the rapid growth of the urban population has led to a worsening in absolute and relative poverty in urban areas. The situation is even worse in Ethiopia (IMF, 2000). Poverty in the Ethiopian context also needs to be considered in its multidimensional characteristics which go beyond mere income and food provision. Such characteristics include aspects of human capabilities, assets, and activities necessary for sustainable livelihood. Urban areas account for only 15 percent of the total Ethiopian population, but have a high rate of incidence of poverty.

To alleviate the overall poverty situation of the country, the government of Ethiopia has designed a 'Poverty Reduction Strategy Paper' (PRSP). The government is also committed to work towards meeting the Millennium Development Goals (MDGs), which include the eradication of extreme poverty by 2015. However; the most important question is how the government is going to achieve that goal. To attain this goal, having full information on the characteristics of the poor and how these characteristics determine poverty becomes of paramount importance (Assefa, 2003).

The population of Tigray region reached 4.314 million with a population growth rate of 2.6% per year CSA (2007), this leads to different socio-economic desires while the region’s potential to serve this high demand is very limited in physical and human resources. More than 58 percent of the regional population live in absolute poverty (earning less than a dollar a day), which makes the region's situation more severe compared to the national average (44.4 percent). The region has also the lowest per capita and per adult equivalent consumption expenditure as compared to other regions of Ethiopia (MoFED, 2002). It is vulnerable to recurrent drought and drastic decline of natural resources, while currently, the regional government together with other development partners is working to reverse this situation. Nonetheless, no detailed study has been undertaken previously on the impact of such interventions and the socio- economic situation of urban areas of the southern zone of Tigrai except the one by WFP which together with UNICEF and Tigrai Regional State made a comparative analysis among five towns of Tigrai (i.e., Maichew, Mekelle, Adigrat, Zelambessa, and Adwa) focusing on poverty, food security, and vulnerability. By all poverty indicators like low asset holding, poor health service, inactive economic dynamism, unemployment, street children and orphans, vulnerability, and the elders without support; Maichew is the poorest town next to Zelambesa (WFP et al, 2008/09).

The prevailing problems of the study are characterized as follow. First, more than seventy percent of monthly income of the society is channelled to consumption, the highest in the region and this high food expenditure is an indicator of low welfare status of the society (WFP et al, 2008/9).Second, growth performance of the town is below that of other similar zonal capital towns of Tigrai region such as Adigrat, Adwa, Axum and Endaselasie (CSA, 1994) in each case. Third, distance to the main road (Addis Ababa to Mekelle), business firms' engagement in the service area of the town like hotels, restaurants, bars and cafes at this time have migrated to other towns closer to the main road and created gloomy prospects for the future business climate (Mathewos, 2008). Forth, annual budget of the town (83%-86%) is allocated for recurrent capital and much of the money is gone to employees' pay without enough working capital and investment (WOFED, 2007). Hence, analyzing the socio-economic and the contributing factors of urban poverty and vulnerability to poverty of the southern zone of Tigrai (the study area) from the demand side (consumption-based) seeks to answer the following research questions. Who are the poor? What poverty indicators are used in the town poverty profile? What are the basic and immediate (proximate) determin of poverty, poverty severity and vulnerability to poverty?

The major objective of the study is to examine the level of poverty and the socio-economic determinants of poverty on the demand side (consumption approach) in Maichew town. The specific objectives of the study are (a) to classify the population as poor and non-poor and calculate the share of the poor from the non-poor; (b) to examine basic determinants of poverty and vulnerability to poverty and (c) to develop poverty profiles of the society and estimate total inequality.

The major significance of the study is to give an insight in to the town administration in designing a means along with the society and regional government to mitigate the prevalence of poverty at a household level. Moreover, this study will help to other researchers as baseline information pertaining to poverty and vulnerability in the case study area. Methodologically, the study is limited only to generate demand side information about the welfare of households in Maichew. Because of the use of cross sectional data to analysis vulnerability to poverty, we miss the effect of aggregate or inter-temporal shocks or the distribution of consumption across households and management of distributional instruments. Shortages of finance also limit the size of the sample survey to be 205 households only.

2. Review of related literature

2.1 Definition, concept and measure of urban poverty

Even though little is known about urban poverty in developing countries due to lack of quantitative data except those which primarily deal with rural poverty (Masika et al, 1997; Dercon, 1999; Ravallion, 2001; Woldehanna, 2004; Hussein, 2003), in recent years an extensive body of literatures come out on the definition, concept and measures of poverty (Kedir, 2003; Baker and Shuler, 2004; Bigesten and Shimles,2005).The World Bank (2000), defines poverty crudely as a pronounced deprivation in well-being. According to this definition, people with greater command on resources are better off in meeting household or individual needs. Masika et al (1997) and Enquobahrie (2004), define poverty as a situation in which the underprivileged don't have adequate food and shelter, lack the right of admission to education and health services, are exposed to violence, and find themselves in a state of joblessness, vulnerability and powerlessness. According to them, poverty is multi-dimensional and looks through a variety of indicators such as levels of income or consumption, social indicators and cursor of vulnerability to risks.

Exclusively to urban poverty, it demands better tools and techniques to differentionate from rural poverty, as the urban poor are more heterogeneous, problematic and segregated socio economic groups and it is hard to increase them cost effectively target (Masika et al,1997; Fay, 2007). Matters incorporate in defining urban poverty from the worldwide pace are of urbanization, the scale and measurement of urban poverty and its spatial and social dimensions. Following this, urban poverty is complex in its nature and difficult to understand (Mitlin, 2006; Biancolli, 2006).

All governments make poverty reduction part of their daily agenda, but how exactly it measures is the tricky issue (World Bank, 2005).There are two approaches used to measure poverty i.e., money metric and non-money metric. For its simplicity, money metric method of poverty measurement is commonly used and, this method is further split into consumption and income approach. In the meantime, consumption approach is preferred to income approach in measuring the extent of poverty because firstly, individuals may not report their actual income during data collection as doing so might reduce their eligibility for cash and in-kind transfers. Secondly, the volatile nature of income misleads to capture the actual poverty figure. Thirdly, consumption is robust to shocks as compared to income and it is quite comprehensive as it incorporates all consumed food and non-food items (Baker and Shuler, 2004; World Bank, 2005; Alemayehu, 2006).

Determinants of poverty generate from different sources and found to differ among methods. The first method used to estimate determinants of poverty is regressing percapita income or consumption against a series of independent variables and the second method is running a probit, or logit regression, where the dependent variable is a binary variable with 1 representing the individual being poor and 0 the non-poor. However, Coudouel et al (2004); Simler et al (2002); and Fagernäs et al (2007), seriously criticized the second method of poverty analysis since artificial construction of the dependent variable and information with reference to the actual relationship between the level of consumption and the dependent variable is lost and then the former method of poverty analysis is widely practiced (World Bank, 2005 and Alemayehu, 2006).

A study run in south east Africa using data from Household Consumption (HC), per capita consumption as a dependent variable from a survey of 593 black households suggests that major determinants of household poverty in urban areas are education and household size (Zake and Naudé, 2002). According to (Kedir, 2005) using panel data in urban Ethiopia indicated that household size composition, economic activities of household head, and schooling are crucial factors of urban poverty. Similarly, Pfau et al (2008), who conducted a research in Vietnam using 2004 Vietnam Household Living Standard Survey (percapita consumption) indicated that; ethnicity, working status, residential regions, household living arrangements, household composition, household head characteristics, as well as receipts of social security benefits and remittances are found to be the basic determinants of urban poverty.

More often than not, the concepts of vulnerability and poverty overlap, but are not indistinguishable (Adesanoye and Okunmadewa, 2007). Technically, vulnerability defined as the susceptibility or sentiment of income or consumption of an individual, household, or community to external shocks (covariant or idiosyncratic) and wavering associates with something detrimental in the future. Scholars like Lankao and Tribbia (2009), argue that urban vulnerability should assess and importantly depends on the circumstance.

Breaking down the contribution of the variables to welfare inequality is another point of discussion in the area of poverty analysis. Information contains about welfare function estimated by a standard semi-log regression answers only how much welfare inequality accounts for each explanatory factor but not exactly how decomposition has been available. For that matter, Fields (2002) develops new frameworks for inequality decomposition footed on the regression-based decomposition that it enables identification as well as quantification of root causes or determinants of inequality.

3. Econometric model specification and data

3.1 The Data

The data used in this study are mainly primary and collected from the randomly selected households' consumption expenditure of Maichew residents in the year 2009. The Data collection process is undertaken through a face to face (personal) interview with the households using household consumption expenditure (HCE) questionnaire. The list of households for this purpose is drawn from 2007 town census enumeration. A total of 205 randomly selected households are included in the survey. The study also incorporated secondary data from the Wereda Finance and Economic Development Office (WoFED), Regional Bureau of Finance and Economic Development (BoFED), national Ministry of Finance and Economic Development and Central Statistics Agency (MoFED and CSA) and other relevant documentary sources. Variable selection for the study, like individual, household, regional, community, economic, idiosyncratic covariate, and demographical characteristics is guided by sound theoretical and empirical backgrounds(See for detail World Bank, 2005; Wooden et al, 2004; Dang et al, 2008; Baker and Shuler, 2004; Kedir and McKa*y*, 2003; Hagos and Holden, 2000; Azem and Imia, 2009).

3.2 Poverty line

The method adopted to estimate the absolute poverty line is Cost of Basic Needs (CBN) and the approach incorporated is Ravallion and Biding (1994). Of course, other methods like Direct Calorie Intake (DCI) and Food Energy Intake (FEI) are also applicable in estimating poverty line but due to overlooking of food basket identification and non-scaling of the quantities corresponding nutritional requirement by DCI and FEI, CBN is widely practiced. Accordingly, from respondents' total expenditure pattern, the poorest 50% of the sample population is identified as a reference group. The food consumption behavior of the reference group is surveyed to determine average quantities per adult equivalent of basic food items that make up the reference food basket.

$$\sum_{i=1}^{23} q_i Kcal_i = T^{*}\text{' with } T \cong T^{*'} \text{. But } T^{*'} \neq T \qquad (1)$$

Where T * = total calorie obtained by individual adult from consuming of the average quantities. q_i = average quantity per adult of food item 'i 'consumed by individual

Kcl_i = the caloric value of the respective food item *'i'* consumed by individual adult

T = recommended calorie of per day per adult (in this case, 2200 kcalorie)

The basket is made up of the mean consumption levels (purchase, remittance, from aid, and own production) of 23 food items. The total calorie obtained from consumption of this basket of average quantity by an individual adult is given as: The ratio of expenditure for each item to total adult size of given household

The average quantity per adult of each food item is scaled up and down by a constant value $\left(\frac{T}{T*}\right)$ so as to provide a total of 2,200 kcalorie per adult per day before doing any activities. Then, each food item is multiplied by the median price and sum up to get a food poverty line .The subsequent step is to estimate the non-food component of the total poverty line. For that end, the non-food share of total expenditure is estimated through regressing the food share (*Si*) of each household 'i' on a constant and the log of the ratio of total consumption expenditure to the food poverty line (Z^f):

$$S_i = \alpha + \beta \log\left(\frac{Y_i}{Z^f}\right) + \varepsilon_i \qquad (2)$$

Where S_i denotes the share of food items from the total household's expenditure, Y_i refers household's total consumption expenditure, Z^f is the food poverty line, β regression coefficient , α typifies intercept of the food share and after subsequent computation for non-food share, the total poverty line becomes:

$$Z^t = Z^f (2 \tilde{-} \alpha) \qquad (3)$$

Welfare information (i.e., consumption expenditure in per adult equivalent) and poverty line for the sampled households are available, analyzing the level of poverty and scrutiny the characteristics and variables associated with it becomes very important (ADB, 2004**;** Baker and Schuler, 2004; World Bank, 2005; Notten and Neubourg, 2007). A widely used group of poverty measures is the Foster Greer, Thorbecke (1984), class of decomposing poverty measure reflects the percentage of poor people as well as the depth and severity of poverty experience down to the poverty line.

3.3 Econometric specification

3.3.1 The consumption model

To identify the determinants of the welfare of household in the study area, a typical regression equation of semi log- linear regression function is used:

$$Log(C_i \quad) = \alpha + \beta^{'} H_i + \delta P_i + \sigma D_i, ..., + \gamma^{'} \ X \quad + \varepsilon_i \quad (4)$$

Where C_i welfare indicator (response variable) refers to consumption expenditure per adult equivalent of household 'i', H is a vector of human capital variables of household head 'i' P is the vector of physical capital variables of households 'i' , D is vector of demographic composition of household 'i' ",α is household's fixed effect that unobserved household heterogeneity, β',σ and δ are vector of regression coefficients and ε_i the disturbance term which accounts for the unexplained part of the model. Method of estimation is GLS (Greene, 2003; Verbeek, 2004).

3.3.2 Determinants of poverty severity

One important point take cares in the measurement of household's welfare in Maichew town is determinant of poverty indices i.e., factors that affect poverty severity. In order to view the poverty severity, (Appleton, 1995), the censored Tobit method is applied and measure of household poverty, Pi, is given as:

$$P_i = \left[\frac{Z_i - C_i}{Z_i} \right]^{\alpha} \quad (5)$$

If $C_i < Z_i$, level of poverty is sever
= 0, otherwise

Where α equals to 2, P_i refers to poverty severity of the household, Z_i presents poverty line and Ci is consumption expenditure of household in per adult equivalent. Since Z_i is censored at the poverty line, modeling this would be equivalent to model a censored dependent variable, $C_i{}^*{}_i$, equals to per adult consumption expenditure of the poor that is fixed at the poverty line for the non-poor. That is to say,

$$C_i^* = X_i \beta + \varepsilon_i \quad (3.6)$$

Where C^*_i is consumption expenditure per adult of household 'i', *Xi* is vector of welfare determinant including household and community characteristics, and β is vector of parameters. The estimates of poverty function are obtained by maximizing the log likelihood function of the above model (see Madalla, 1999).

3.3.3 Vulnerability to poverty

In this study, the measure proposed by Chaudhuri (2003); Chaudhuri, and Suryahadi, (2002) is used to measure vulnerability to poverty. According to Chaudhuri (2003), for a given household *h*, the vulnerability to poverty is defined as the probability of household's per adult consumption expenditure being below poverty line at time *t+1*:

$$V_{ht} = P_r\left(\ln C_{h,t+1} \prec \ln \underline{C}\right) \tag{7}$$

Where V_{ht} is vulnerability of household *h* at time *t*, $C_{h,t+1}$ denotes the per adult consumption expenditure of household *h* at time *t+1* and $\ln\underline{C}$ stands for the poverty line. For household *h* the data generation process for consumption is captured in the following equation:

$$\ln C_h = X_h{}'\beta + \varepsilon_h \tag{8}$$

Where C_h stands for per adult consumption expenditure for household *h*, X_h represents a vector of observable household characteristics (both idiosyncratic and covariate variables), β is a vector of parameters, and ε_h is a mean-zero disturbance term that captures household's idiosyncratic factors (shocks) contributing to differential level of per adult consumption for households that shared the same characteristics:

$$\hat{V}_h = \hat{P}_r\left(\ln C_h \prec \ln \underline{C} \,\middle|\, X_h\right) = \Phi\left[\frac{\ln \underline{C} - X_h\hat{\beta}}{\hat{\sigma}}\right] \tag{9}$$

$\hat{V}_h$ denotes vulnerability to poverty, which is the probability of per adult consumption level of each household ($\ln C_h$) lower than the poverty line ($\ln\underline{C}$) conditional on idiosyncratic and covariant variables X_h. Meanwhile, $\Phi(.)$ denotes the cumulative density of the standard normal distribution and $\hat{\sigma}$ is the standard error of the equation. To have consistent estimate of parameters, it is necessary to address the problem of heteroskedasticity, that is, variances of the disturbance term varies across time as the explanatory variables vary. For that end, the variance of error term for equation (3.8) is expressed as:

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$$\sigma^2{}_h = X_h\theta + \eta_h \quad (10)$$

A three-stage Feasible Generalized Least Square (3FGLS) method is applied to estimate the parameter θ. For that matter, first, equation (5.8) is estimated using an ordinary least square (OLS) method and the residual value of this equation is determined from the difference of actual and estimated log consumption expenditure. Then, squaring this residual value and found ($\hat{e}^2{}_{OLS,h}$).Take this as a dependent variable, formulate an equation (5.10) and again OLS method is applied. Lastly, the residual value of equation (5.10) is also estimated from the difference of the actual residual ($\hat{e}^2{}_{OLS,h}$) and its estimated residual. The estimate from above analysis is then used to transform the equation (5.10) into the following:

$$\frac{\hat{e}^2{}_{OLS,h}}{X_h\hat{\theta}_{OLS}} = \left[\frac{X_h}{X_h\hat{\theta}_{OLS}}\right]\theta + \frac{\eta_h}{X_h\hat{\theta}_{OLS}} \quad (11)$$

Where $X_h\hat{\theta}_{OLS} = e^2{}_{e,h}$, the variance of the error term

This transformed equation is again estimated using OLS to obtain an asymptotically efficient FGLS estimate, $\hat{\theta}\ FGLS$. $X_h\hat{\theta}\ FGLS\ is\ \sigma^2{}_{e,h}$ which is the variance of the individual component of household consumption per adult and this, is further used to transform equation (5.8) into the following:

$$\frac{\ln C_h}{\sqrt{X_h \hat{\theta}\ FGLS}} = \left[\frac{X_h}{\sqrt{X_h \hat{\theta}\ FGLS}} \right] \beta + \frac{eh}{\sqrt{X_h \hat{\theta} FGLS}} \qquad (12)$$

Where $\ln C_h$ denotes per adult consumption expenditure of household h, X_h refers characteristics to household h (idiosyncratic and covariate), β represents vector of regression coefficient, and e_h stands for standard error ($\sqrt{X_h \hat{\theta}\ FGLS}$ = $\hat{e}_{e,h}$) the estimated standard error. OLS estimation of equation (5.12) yields consistent and asymptotically efficient estimate of β. Finally, the estimates of β and θ are obtained through 3FGLS method and used to estimate the vulnerability to poverty of each household in the town through the following generalized equation (See for detail Azam and Imai, 2009; Dang et al, 2009).

$$V*_h = \Phi \left(\frac{\ln \underline{C} - X_h \hat{\beta}}{\hat{\sigma}} \right) \qquad (13)$$

Therefore, the expected log consumption per adult equivalent of each household is explained as;

$$\hat{E}(\ln C_h / X_h) = X_h \hat{\beta} \qquad (14)$$

And the variance of log consumption per adult equivalent of household h is given as:

$$\hat{V}\ (\ln C_h / X_h) = e^2{}_{e,h} = X_h \hat{\theta} \qquad (15)$$

Furthermore, vulnerability is also affected by variables which are highly pretentious to wellbeing on a number of counts. Thus, the model below (3.16) is applied to examine the idiosyncratic and covariant determinants of vulnerability to poverty of each household in the study area.

$$V_h \quad = X_h{}^{'}\Psi + \mu_h \tag{16}$$

Where $\widehat{V}_h$ is the estimated vulnerability of household h from equation (5.13), X_h is the vector of household h idiosyncratic and covariant characteristics captured from household survey, Ψ is vector of coefficients, μ_h is. the error term. Method of analysis is d OLS.

Moreover, to compare and figure out welfare inequality of the households in the study area, Lorenz curve analysis is applied and defined as:

$$L(P) \quad = \frac{\int_0^p Q(q)dq}{\int_0^1 Q(q)dq} \quad = \frac{1}{\mu}\int_0^p Q(q)dq \tag{17}$$

Where $\int_0^p Q(q)dq$ sums per adult consumption expenditure of the bottom *'p'* proportion (the poorest 'p' multiplied by 100).

$\int_0^1 Q(q)dq$ sums per adult consumption expenditure of all the entire sample population (Araar, 2006).

The magnitude on welfare inequality (Gini index) of the society is estimated with the help of Distributive Analysis / Analysis Distributive (DAD) soft ware (Araar, 2006) as follow:

$$\frac{Gini\ index\ inequality}{2} = \int_0^1 (P - L(P))dp \tag{18}$$

Alternatively, vertical decomposition of welfare inequality depends on the consumption expenditure variation function that is expressed as (Fields, 2002):

$$\ln C_i \quad = a_j Z_j \tag{19}$$

a_j = coefficient of explanatory variables in GLS method of estimation.

Z_j = determinants of welfare in factor analysis and
$\ln C_i$ = welfare indicator i.e., log per adult consumption expenditure.

Having good estimates for the coefficients on the variables (i.e., in GLS estimation), the next step is dealing with the decomposition of the log-variance of the dependent variable. For that matter, the variance of both sides of (3.19) is taken and the left hand side of the equation measures the inequality of log variance (consumption expenditure) and the variance of the right hand side of the equation is further manipulated (see theorem of Mood, Graybill, and Boes, 1974**).**

Then, the log-variance of consumption is decomposed as follow:

$$s_i(\ln C_i) = \frac{\operatorname{cov}\lfloor a_j Z_j, \ln C_i \rfloor}{\sigma^2(\ln C_i)} = \frac{a_j * \sigma(Z_j) * cor[Z_i, \ln C_i]}{\sigma(\ln C_i)} \qquad (20)$$

Where s_i is relative factor inequality weight, a_j refers coefficient of explanatory factor 'j' in GLS estimation, $\sigma(Z_j)$ represents standard deviation of the explanatory factor $Z_{j,}$ $\sigma(\ln C_i)$ typifies standard deviation of the log consumption expenditure, $\sigma^2(\ln C_i)$ is variance of log consumption expenditure. The correlation between explanatory variable and log consumption expenditure i.e., $cor\lfloor Z_j, \ln C_i \rfloor$ is also further articulated as (see Fields, 2002 for the proof).

$$cor[Z_j, \ln C_i] = \frac{\operatorname{cov}\lfloor Z_j, \ln C_i \rfloor}{\sigma(Z_j) * \sigma(\ln C_i)} \qquad (21)$$

Finally, (equation 5.20) becomes

$$s_i(\ln C_i) = a_j * \operatorname{cov}\lfloor Z_j, \ln C_i \rfloor$$ (22) then, apply OLS.

4. Results and discussion

4.1 Descriptive analysis of the survey data

Out of the total respondents, 131 (63.90%) are male headed households and the rest 74 (36.10%) are female headed households which is similar to the finding of Meehan (2004) that over 30 percent of Tigray population are estimated to be de facto female headed households. The average family size of the sample households is 4.73 and ranges from 1 (five households) to 14(one household). The majority of households have five members in their family. The average age of household heads is 48.1 years and it varies from 19 to 90 years. The level of education of household head is sorted from no education (illiterate) to higher education graduates. Of all the household heads involved in the sample, the major occupation of the household heads is disclosed as 23 (11.21%) engaged in farming, 53(25.85%) in informal and formal trading activities also known as petty trade, 56(27.31%) are civil servants, 16 (7.8%) are daily laborers, 13 (6.34%) are pensioners, and 12(5.85%) household heads are engaged in handcraft activities. The remaining are beggars, police, and unemployed house wives (see Table 1) below:

Table 1: Socio-economic Characteristics of Respondents

Household Variable	Obs.	Mean	Min	Max
Family size	205	4.73	1.	14
Dependence ratio	205	0.71	0	6
Head age	205	48.08	19	90
head female,	74	0.39	0	1
Head educ(years of education)	205	6.69	0	16
Head farmer	23	0.95	0	1
Head petty	53	1	0	1
Head daily worker	16	1	0	1
Head Civil servant	56	0.27	0	1
Head housewife	7	1	0	1
Head handcraft	12	1	0	1
Head pension	13	1	0	1
Head police	2	1	0	1
Head beggars	4	1	0	1
Head married	116	1	0	1
Head separated	14	1	0	1
Head Divorced	19	1	0	1
Head widowed	56	1	0	1
Head single	4	1	0	1
Saving acct	90	.44	0	1
Access to credit	205	0.49	0	1

Source: Computed from own survey, 2009.

The marital status of the respondents shows that 116(56.58%) of respondents are married, 19(9.27%) divorced, 56(27.32%) widowed (either husband or wife is dead) and 14(6.83%) are separated. Female headed households have smaller family size as compared to their male headed counterparts. This might be due to the fact that the chance of remarrying for a widow is much lower than a widower. However, female headed households are suffering of low warfare as compare to male headed households. This study confirms the findings in urban Amhara by Kodama (2008) and in urban Ethiopia by Alem and Soderblom (2010) that consumption is somewhat lower in households in which the head is female. In order to assess the ability of households to cope up with current and future welfare shocks, households are asked whether they have a saving habit or not. Accordingly, the survey result revealed that only 90(43.9%) of the respondents have the practice of saving. According to the survey, 39.21 % of households have at least one unproductive person in the family (age less than 15 and above 64 years) which extended from 0 to 6 per household and out of the total respondents 41(20%) of the household heads are unproductive (above 64 years). As a result, the mean size of dependence ratio is 0.7 which means that one productive person supports on average 0.71 unproductive persons which analogs to Kedir and McKay (2003) strong relation of poverty with households having high dependency rates in urban Ethiopian. Table 2 characterizes households surviving with no access to service facilities like safe water, electricity, telephone, and sanitation.

Table 2: Households Inaccessibility to Services (n=205)

Type of service facility	Number and percentage of HHs in access to service	
	Number	Percentage
Own water pipe line	76	37
Electricity service	24	12
Sanitation Service	55	27
Telephone service (landline)	122	60
Residential house	52	25

Source: Computed from own Survey, 2009.

Table 2 indicates that76 (37 %) of the sample households do not own private water pipe line and are obliged to use other sources for daily consumption at high opportunity cost. Concerning other services like electricity, sanitation and landline telephone, 24 (12%) never received electricity as a source of light and 55(27%) of the respondents don't have any sanitation service. Moreover, 122(60%) of the household respondents don't have a telephone line. Residential housing condition of the respondents indicate that 52(25%) live on either rented houses or relatives houses with poor quality. Similar conclusion was reached by Baden, et al (1997) where lack of access to secure and safe housing is a central feature of urban poverty in developing countries. The opening of the new Alamata –Mohoni -Hiwane road affects negatively the business climate in Maichew. This forced many petty and small operators to close their shops and move to other places. Although it requires further detailed investigation how far the opening of the new Alamata - Mehoni–Hiwane road affects negatively the growth momentum of the town of Maichew and the well-being of its people, 189(92.19%) of the respondents realized that one way or the other, the road diversion made a gloomy future for the growth of the town as well as to its inhabitants. This finding is not different from that of Baker and Shuler (2004) that alienation from road service contributes more to the aggravation of urban poverty in developing countries. (Summary statistics of the variables is presented in Annex Table 1).

4.2 Measuring poverty

The poverty line used in this study is derived from the households' consumption expenditure for food and non-food items. The poverty line is set using the Cost of Basic Needs (CBN) approach. Accordingly, the absolute poverty line is estimated in per adult equivalent at current market price and illustrated in Table 3 below.

Table 3: Poverty Line Per Month of the Study Area in Birr

Poverty line	Values At market price	Price deflated to (2006 base year price)
Food poverty	187	85
Non-food poverty	64	66
Total poverty	251	151

Source: Computed from own survey data, 2009.

This market price poverty line reflects the norm, culture, taste and preference of the society situated in the study area. Compared to the base year price index, the current market price index is higher by approximately 100 ETB, and this is the result of the ever increasing price of food items (see Annex Table 3: computation of food poverty line). However, poverty comparison between 2006 and 2009 is difficult due to the inconsistence of food basket in the two different times. Accordingly, third column of Table 3 shows only deflation of the current expenditures to base year price (2006 base year). The sensitivity of the current market price poverty line is checked by taking upper and lower values[4].

Table 4 presents the poverty indices calculated from food and total poverty lines of ETB 187 and ETB 251 respectively. To estimate the poverty line, Version 4.5 of the Distributive Analysis/ Analysis of Distributive (DAD) soft ware is used (Araar, 2006). Aligned to total poverty line, absolute head count ratio stands 0.3170 indicated that on average 31.70% of the sample population in Maichew is unable to meet the stipulated minimum level of caloric intake i.e., 2200 kcal per adult equivalence per

[4] Take the upper poverty line ETB 261 and the lower one ETB 241. Accordingly, for the upward movement of poverty line by 4% (i.e., ETB 261) head count index is increased by 10.7% and poverty gap and poverty severity also raised by 10% and 9.45% respectively. Similarly for the lower value (i.e., poverty line ETB 241), head count index is decreased by 12.67% and poverty gap and poverty severity also declined by 9.5% and 9% respectively. Hence, the poverty line exhibited a sensitive nature to upper and lower value.

day. Although headcount ratio has great virtues in understanding, it lacks information about the intensity of poverty and it overlooks telling how the poor are poorer.

Table 4: Poverty Indices at Maichew Town (n=205)

Poverty index	Food Poverty (MktP)	Stand. Error	Total Poverty (MktP)	Stand. Error	Confidence limit (%)
Head count(P_0)	0.3024	0.01	0.3170	0.03	95.000
Poverty gap(P_1)	0.0852	0.01	0.0894	0.01	95.000
Poverty gap Square(P_2)	0.0357	0.01	0.0375	0.01	95.000

Source: Computed from Own Survey Data, 2009.

Poverty gap measures the mean proportionate gap of the welfare of households in which the non-poor have zero poverty gaps. Table 4 also shows that the mean difference between the total poverty line and the consumption expenditure of the poor is 8.9%.

The Poverty Gap Square shows the weighted sum of poverty gaps as another version of severity of poverty measure and it is found to be about 3.75%. The share of the population whose consumption expenditure below the food poverty line is about 30.24% (1.46% less than the proportion of people who are under poverty line in terms of total expenditure). This implies that food poverty contributes more to aggravate total poverty. The food poverty gap indicated that on average poor households are 8.5% far off from the food poverty line. Severity of food poverty of the sample household is 0.5%.

Table 5: Description and Values of Explanatory Variables

Variable list	Description	Measured Value
Family size	Size of household member	Number of family per household
Head age	Age of household head	Years old of household head
Headage2	Square of household head	Square of years old household head
Children less than 7~years	Size of children less than 7years	Number of children less than 7 years old in a given household
Children between 7~14years	Size of children between 7- 14 years	Number of children between 7 -14 years old in given household
Dependence ratio	Number of dependence in given household	Under 15years plus above 60 years divided to size of productive household member
Head female	Head of the household is female	Yes =1, 0 otherwise
Head education	Education level of household head	Years of education of household head
Spouse education	Education level of the spouse of the household head	Years of education of household's spouse
Head farmer	Occupation of household head is farming	Yes =1, 0 otherwise
Head petty trade	Occupation of household head is petty trade	Yes =1, 0 otherwise
Head pensioner	Occupation of household head is pensioner	Yes =1 , 0 otherwise
Head civil servant	Occupation of household is civil servant	Yes =1 ,0 otherwise
Head married	Marital status of household head is married	Yes =1, 0 otherwise
Head divorced	Marital status of household head is divorced	Yes =1, 0 otherwise
Head widowed	Marital status of household head is widowed	Yes =1, 0 otherwise
Saving acct	Household has saving account	Yes = 1, 0 otherwise
Orphans	Household has an orphans	Yes =1, 0 otherwise
Access to credit	Household has an access to credit	Yes =1, 0 otherwise
Housing quality index	Quality of household residential house	Between (0-1)
Property index	Household owns common durable goods.	Between (0-1)
Service index	Household access to common service	Between (0-1)
Head Social transition	Social status of household head	Improved =1, 0otherwise

Source: Computed from own survey data, 2009.

4.3 Econometric results and discussion

4.3.1 Determinants of poverty

To start with multivariate analysis, a simple correlation coefficient matrix is done in order to test whether multicollinearity is present or not among the explanatory variables and found no severe problem since the correlation matrix results are less than 0.8 and Variation Inflation Factor (VIF) is less than 10 with the exception of the correlation between age and age squared which is high as expected.

It is noted that the dependent variable of the model is the natural logarithm of real consumption per adult equivalent, and hence the regression coefficients are measured the percentage change in consumption per adult equivalent for changes in the explanatory variable. Owing to the cross sectional nature of the data, problem of heteroskedasticity is likely to prevail which means that as the value of the independent variables vary, the value of error terms also diverge. The presence of heteroskedasticity is sensed via the Cook-Weisberg test for heteroskedasticity (estat hettest) and the null hypothesis of hemoskedasticity is rejected at 5% level of significance. To overcome the problem, an alternative estimator is derived by transforming the original data into hemoskedasticity error terms with the application of Generalized Least Square (GLS) method.

Besides the problem of heteroskedasticity, there is also a suspicion of problem of endogeniety i,e., a correlation between the explanatory variables and the error term and its existence is checked using Hausman endogeniety test. At 5% significant level, the null hypothesis for endogient is accepted and there is no endogeniety problem in the data. The P- value is assured to the probability for the two tail test for rejecting of the null hypothesis over the level of significance (i.e., 95% CI by default) of slope coefficients of each variable. The F-value, 11.63, is shown that the overall model for the estimates of the GLS regression as a good fit. According to the results displayed in Table 6 shown below, holding other variables constant, households with more family members exhibited lower welfare, which is a similar trend in most of urban areas in Ethiopia as confirmed by other research findings (see Alemayehu, 2006; Worako (2009). Everything else being constant, adding one more member to a household reduced the welfare of the household by 13.4%. Age of household head is positively related to household's welfare at 5% level of significance. This implies that the older the head of household, the better is the welfare of that household keeping other variables constant. This result resembled to the finding of Worako (2009) in urban Ethiopia that age of a household head has positive impact on the consumption of all grain products but in significant at 5%.

Table 6: GLS Regression Result of Welfare Function

Dependent variable: Log per adult equivalence consumption expenditure			
Explanatory variables	**Coefficient**	**t-value**	**P>|t|**
Head age	.041**	2.34	0.020
Headage2	-.001**	-2.16	0.032
Family size	-.134***	-4.75	0.000
Children less than 7 years	.052	0.90	0.369
Children between 7~14years	-.033	-0.77	0.445
Dependence ratio	.060	0.95	0.345
Head female	-.135	-1.64	0.103
Head education	.035***	3.09	0.002
Spouse education	.010	1.28	0.203
Head farmer	.082	0.63	0.532
Head petty trade	.174*	1.73	0.086
Head pension	-.182	-1.10	0.274
Head civil servant	-.124	-0.94	0.348
Head married	-.132	-0.73	0.469
Head divorced	-.558***	-2.96	0.004
Head widowed	-.280*	-1.70	0.091
Saving account	0.013	0.16	0.873
Orphans	-0.063	-0.27	0.565
Access to credit	-.020	-0.27	0.787
Housing quality index	0.565*	1.92	0.056
Property index	1.149***	4.86	0.000
Service index	0.313***	2.61	0.005
Head social transition	-0.434**	-2.32	0.022
Constant	20.33***	10.21	0.000
Number of obs = 205	F (23, 182) = 11.63		
Prob > F = 0.0000			

Source: Computed from own survey (2009).

** Significant at 10%, **Significant at the 5% level; ***Significant at the 1% level*

Prob > F = 0.000 stands for the significance of the overall model

The above Table 6 also disclosed divorced and widowed household heads have lower level of welfare and the effect is significant at 1 % and 10% respectively. From Table 6, one can infer that housing quality index and property index are positively related with household's welfare. Concerning the marginal effect, increasing in the housing quality index and property index by one, the welfare of that household is increased by 56.5% and 114.9 % respectively. Gender of a household head has a negative but insignificant impact on household welfare. Table 6, also presented about the welfare level across different job categories of household heads. Accordingly, being petty trade household head keeping other variables constant has positive relationship with welfare and its marginal effect is resulted in increasing welfare of household on average by 17.4%.

4.3.2 Determinants of poverty severity (Tobit Model)

Tobit model is different from the binary choice model because the latent variable is observable (i.e., $y^* \leq$ poverty line). Estimation results are shown in Table 7. Households with more family size have a higher probability of falling to poverty gap square. With respect to marginal effect for increasing of family size by one member, the probability of falling to poverty gap square is increased by 12%. The married and divorced households are significant and positively related with poverty gap square at 5% level of significance. Being divorced and married head of household increases the probability of being exposed to severity to poverty by 46.6% and 36.8% respectively. The possible reason for this might be increasing of family members for the married household headed and shrinking of income from the spouse side for the divorced household headed.

Educated household head is inversely correlated with poverty gap square and significantly at 5% level which is consistent to the study of Mwabu, et al (2005) in Kenya that the most important negative determinant to incidence of poverty status is the level of education. Disaggregating headship by job classification suggested civil servants and those engaged in petty trade have lower level of severity of poverty than pensioners at 5% level of significance. Age of household head is negatively associated with the poverty gap square. Households headed by young person have relatively a lower poverty severity than households headed by aged household heads. Likewise households headed by pensioners have a wider poverty severity than households headed by civil servants.

Table 7: Determinants of Severity of Poverty (Tobit Model)

Dependent variable :(P_2) Poverty Severity

Explanatory Variables	Coefficients	dy/dx	t-value	P>|t|
H Head age	-.124*	-.030	-1.78	0.07
H Head at age 2	.001*	.0002	1.74	0.089
Family size	.493***	.120	4.49	0.000
Adult between 15~64 years	.053	.012	0.43	0.411
Elder above 64 years	-.776**	-.189	-2.02	0.034
Head female	.294	.073	0.54	0.60
Head education	-.112**	-.027	-2.46	0.011
Spouse education	-.106***	-.026	-2.62	0.002
Head farmer	.102	.025	0.250	0.990
Head petty trade	-.633**	-.142	-1.81	0.029
Head pension	.894**	.247	1.582	0.025
Head civil servant	-.483**	-.111	-0.88	0.020
Head married	1.655**	.368	1.90	0.022
Head divorced	1.66**	.466	2.21	0.014
Head widowed	1.20	.318	1.68	0.228
Saving account	.286	.070	0.970	0.373
Orphans	.124	.031	0.97	0.866
Access to credit	-.322	-.078	-1.15	0.320
Housing quality index	0.683	0.166	1.51	0.362
Property index	-0.066***	-0.236	-4.08	0.003
Service index	-0.794**	-0.194	-1.88	0.023
Head social transition	-0.744	-0.182	-0.51	0.904
constant	1.795	-	1.03	0.100
Number of Obs = 205				
Psedo R^2 = 0.389				
Log likelihood = -133.86				

Source: Computed from own Survey Report (2009).

*Significant at the 10% level; **Significant at the 5% level; *** Significant at the 1% level

4.3.3 Extent of vulnerability to poverty

Three stage FGLS result indicated that on average 40% of the society in the town is vulnerable to poverty (the highest is 89% and the lowest 4.1%).This outcome told us the probability of falling into poverty in a period a head is 0.40 which implies that the poverty head count index in the next period. In line with Chaudhuri (2003), choosing the focal point to be 0.5 where the household becomes vulnerable to poverty, 31.5% of the sampled households are found to be vulnerable to poverty and out of this, 37.

3% are female headed households. In the mean time, expected log consumption per adult equivalent is estimated and has positive correlation with households headed by civil servants and petty trade and negatively affected by households faced shortage of money for purchasing food and more family size keeping other variables constant. This result is not different from Azem and Imia (2009) in urban Bangladesh that size of household has positive effect on vulnerability to poverty.

Table 8: GLS Regression: The Expected and Variance of Log per Adult Equivalent Consumption Expenditure

Dependent Variables:	***E(lnC/X)***		***Var(lnC / X)***	
Explanatory Variables	**Coefficient**	**Std. error**	**Coefficient**	**Std. error**
Assets old	4.604	5.685		
Family size	-.521***	.107	.120***	.036
Orphan Size	-.175	.424	.257	.545
Head pensioner	-.027	.215		
Head death	-16.474	19.127		
Road diversion	.008	.077	.756	1.871
Head farmer	-.036	.216	1.474**	.683
Head petty trade	.208**	.089	.044	.237
Head civil servant	3.197****	.740		
Head widowed	-17.79	13.394		
Head divorce	.282**	.128	-1.578**	.648
Shortage of money to purchase food	-.236***	.087		
High food price	-.183	.128	-6.64	4.227
Constant	6.60***	.250	6.512***	.257
	Number of observation = 202 F(14, 188) = 4.08 Prob > F = 0.0000 R-squared = 0.2610 Adj R-squared= 0.1971		Number of obs = 202 F(8, 194) = 3.12 Prob > F = 0.0010 R-squared = 0.1405 Adj R-squared = 0.0955	

Source: Computed from own survey, 2009.
**Significant at the 5% level; ***Significant at the 1% level.

Following 3FGLS estimation of vulnerability, factors that influence the vulnerability to poverty, is estimated via OLS method. Accordingly, Table 9 below indicates that variable coefficients with negative sign stand against vulnerability to poverty and coefficients with positive sign have positive correlation with vulnerability and hence drive the households to poverty. In view of that, increase of member of households by one person, the chance of vulnerability to poverty of that household is increased by

3.7 % keeping other variables' effect constant. This basically conforms to other studies that more family size increased vulnerability to poverty (World Bank, 2002). On the other hand, being civil servant household headed the probability of vulnerability to poverty is decreased by 19%. This might be due to the constant flow of income to government employees.

Table 9: OLS regression: Correlates of vulnerability to poverty

Dependent Variable: Vulnerability to pover*ty(Vu)*

Explanatory variables	**Coefficient**	**t-value**	**P>|t|**
Family size	.037***	5.93	0.000
Dependence ratio	.009	0.74	0.458
Head female	.11***	-2.71	0.007
Head petty trade	-.097***	-11.19	0.002
Head handicraft	.064 ***	5.97	0.001
Head farmer	.023	0.56	0.573
Head civil servant	-.190***	-6.15	0.000
Head married	.054**	2.16	0.032
Head pensioner	.01	0.21	0.837
Head widowed	.110***	2.96	0.003
Head divorced	.228***	4.42	0.000
Head separated	*-.017*	-0.21	0.775
Money Shortage to purchase food	*.027****	4.05	0.000
Head death	*-.017*	-0.56	0.578
Orphans	*.027*	0.80	0.426
Road diversion	*.081**	1.90	0.060
Family illness	*-.070****	-2.70	0.008
Asset Sold	*.009*	0.18	0.858
High food price	*.048**	1.76	0.081
_Constant	*.099**	1.72	0.088
R-squared = 0.4668	Prob > F = 0.0000		
Number of obs = 203	F(19, 184) = 8.90		

Source: Computed from Own Survey, 2009.

**Significant at the 5% level; ***Significant at the 1% level

4.3.4 Inequality and poverty

The simplest way to measure inequality among individual households is by dividing the whole population from the poorest to the richest and show the percentage of consumption expenditure attributed to each quintile of the population.

Table 10: Summary of Adult Consumption Expenditure in Each Quintile

Quintile group	Mean	Std. Dev.	% of mean expenditure	Freq
First quintile	156	32.22	6.37	41
Second quintile	253	24.11	10.33	41
Third quintile	341	29.26	13.93	41
Forth quintile	489	61.55	19.98	41
Fifth quintile	1209	1174.07	49.39	41
Total	2448	638.77	100.00	205

Source: Computed from own survey, 2009.

From Table 10, one can deduce that the poorest quintile (i.e., the poorest 20%) consumes only 6.37% of the mean expenditures per month per adult, while the share of the richest quintile (i.e., the richest 20%) is 49.39%. Furthermore, the mean expenditure of the first three quintiles (i.e., the poorest 60%) is 30.63% still smaller than the share of the richest 20%. The most widely used single measure of inequality is the Gini coefficient and it ranges between 0 perfect equality to 1 perfect inequality. Gini coefficient is determined using Distributive Analysis / Analysis of Distributive (DAD) soft ware (Araar, 2006) and total inequality is as 0.49. One may also analyze the nature and causes of change in inequality of welfare over the entire society.

Table 11: Factors Determining Consumption Expenditure Inequality

Explanatory Variables	GLS Coefficients	Factor inequality weight
Head age	.041**	0.033
Head age 2	-.001**	-0.0001
Family size	-.134***	0.018
Children less than 7 years	.052	
Children between 7~14years	-.033	
Dependence ratio	.060	
Head female	-135	0.059
Head education	.035***	0.032
Spouse education	.010	
Head petty trade	.174*	0.029
Head farmer	.082	
Head pension	-.182	
Head civil servant	-.124	
Head married	-.132	
Head divorced	-.558***	-.083
Head widowed	-.280*	-.028
Saving account	.013	
Orphans	-.063	
Access to credit	-.020	
Housing quality index	0.565*	.032
Property Index	1.149***	0.146
Service index	.313***	0.049
Head Social transition	-.434**	0.124
Residual	-	0.59

Source: Computed from own survey, 2009

* Significant at 10% ** significant at 5% *** significant at 1%

Using the coefficients of GLS method, the welfare inequality is decomposed to its determinants. Next to the residual, the factor with the greatest contribution for welfare inequality is property index. Difference in ownership of durable property is explained by 14.6% of the difference in average consumption expenditure. Social transition is the next strongest determinant of inequality which is 12.4% of the variation in average consumption. Differences in level of household head education contribution to inequality is only 3%. Housing quality and service indices are other important factors that shaped the structure of consumption inequality in Maichew. Age of household head has a concave shape relationship with inequality. At the early age, inequality is increased with increasing age but at later age inequality is decreased though the magnitude is negligible.

5. Conclusion and policy implication

5.1 Conclusion

The paper tries to assess household poverty level, vulnerability to poverty and inequality in Maichew town of Tigray regional state. A combination of methods has been used in the analysis. GLS method is applied to estimate the coefficients of the possible determinants of households' welfare (per adult consumption expenditure) against a series of independent variables. Family size, age square of household head, orphans size, pensioner household head significantly are negatively associated to welfare of households. On the contrary, variables capturing petty trade household heads, increased years of education of household head and spouse, households with more property index, equipped housing service are positively correlated with welfare. Determinants of poverty severity are investigated with the dependent variable being continuous with limited range. The estimation of a Tobit depicts that being pensioner headed households shows a positive relationship to poverty severity at 5% level of significance.

Another important point addressed by this study in the extent of vulnerability to poverty at societal level. Using three stages FGLS method, mean vulnerability to poverty of the society is found to be an average of 40%. This is nothing but an indication of poverty head count next period. GLS results also show that expected log per adult consumption expenditure is positively related to households headed by civil servant and petty trade. Along with the estimation of expected consumption and variance of expected log consumption, factors that influence vulnerability to poverty is also analyzed using OLS method.

Survey data revealed that there is a great variation in consumption expenditure of the households which ranges from Birr 56 to Birr 7035 per adult equivalent. The estimated Gini coefficient is found to be 0.49 which is consistent with income or wealth inequality of developing countries. Decomposing welfare inequality on its determinants or the factor contribution using regression based decomposing method shows that next to the residual, physical capital (property index) and human capital (head social transition) take the greater share in creating welfare inequality respectively.

5.2 Policy implication

The study leads to a fair conclusion that households headed by persons involved in petty trade are in a good position in welfare perspective and they have a better potential to resist and combat the lane that leads to poverty. Therefore, supporting the informal petty traders becomes a sound intervention. Meanwhile households headed by divorced and widowed are found in the worst welfare condition. Thus, organizing and supporting these types of households to be involved in small and micro enterprises could be a better way of mitigating poverty.

Albeit efforts to discuss poverty in many ways in this paper, we admit a lot remains to be done in this area for future research. Thus, the following suggestions are forwarded: Most of the works on welfare are focused on measuring and identifying the correlates of poverty and inequality but much effort should be exerted to diagnose the root causes of poverty. The study uses only one wave of household survey and it lacks a time dimension. Thus, additional household survey becomes crucial to assess the dynamics of poverty overtime and also see the situation in a different perspective.

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Appendices

Annex Table 1: Summary of descriptive statistics of the survey (partial)

Variable	Obs .	Mean	Std. Dev	Min	Max
Family size	205	4.73	2.02	1.	14
Children less than 7yrs	205	0.51	.71	0	4
Children b/n 7~14yrs	205	1.00	1.07	0	6
Adult equivalent size	205	3.99	1.75	0.74	12.44
Wealth index	205	0.49	0.41	0.13	0.91
Asset index	205	0.13	0.12	0.03	0.85
Dependence ratio	205	0.71	0.88	0	6
Head age	205	48.08	14.67	19	90
head female, yes =1, 0 otherwise	205	0.39	0.72	0	1
Head educ. (years of education)	205	6.69	6.25	0	16
Head farmer (dummy yes, = 1,0 otherwise)	24	0.95	0.20	0	1
Head petty trade (dummy yes=1, 0 otherwise)	53	1	0	0	1
Head daily worker(dummy yes =1, 0 otherwise)	16	1	0	0	1
Head housewife(dummy yes = 1, 0 otherwise)	7	1	0	0	1
Head handicraft(dummy yes 1, 0 otherwise)	12	1	0	0	1
Head pension(yes=1, 0 otherwise)	12	1	0	0	1
Head police(dummy yes= 1, 0 otherwise)	2	1	0	0	1
Head married(dummy yes=1, 0 otherwise)	116	1	0	0	1
Head divorced(dummy yes= 1, 0 otherwise)	19	1	0	0	1
Head widowed(dummy yes= 1, 0 otherwise)	56	1	0	0	1
Head single(dummy yes =1,0 otherwise)	4	1	0	0	1
Head separated(dummyyes=1,0 otherwise)	14	1	0	0	1
Spouse education(yrs of education)	106	5.57	5.98	0	16
Residential house(dummy, yes =1 own, 0 otherwise)	205	0.76	0.43	0	1
Social transition(dummy deteriorate = 0, 1, improved)	205	-.15	0.99	-1	1
Saving acct(dummy = 1 own, 0 otherwise)	90	.44	.49	0	1

Source: computed from own survey, 2009.

Annex Table 2: Energy content per 100 gm of edible portion of food items consumed by the bottom 50% poor.

Food Items	Kilocaloric value	Food Items	Kilo caloric value
Wheat	351	Galaric	149
Teff	341	Berebery(red pipper)	318
Barely	354	Cooking oil	884
Maize	362	Coffee	2
Beans	344	Sugar	400
Lents	370	Beef	235
Onion	42	Chicken	140
Tea	29	Sorghum	347
Tomato	70	Chick peas(Shimbira)	341
Potato	87	Egg	68
Cabbage(T.gomen)	25	Soybean(Dekeko)	405
Salt	0		

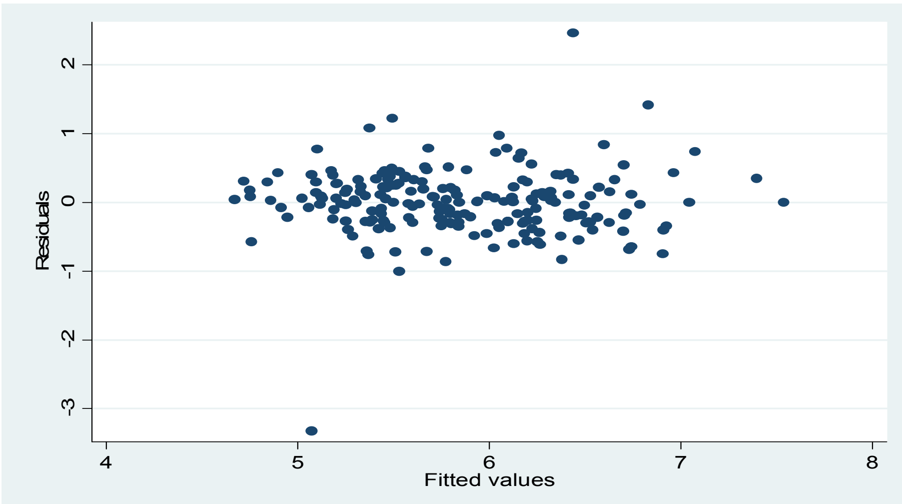
Source: WHO

Annex Table 3: Computation of Food poverty Line (Current market price)

Food items	Av.Con. per adult per month/kg of food items(A)	Caloric value of each food(B)	Total calories peradu.eq per month (C=A*B*10)	Scaling up/down of A $D=\left[\frac{66000}{562109}\right]*A$	Median price of each food items	Food poverty line per monthly (Birr)
Wheat	2.24	351	7,862.40	2.63	6.2	16.31
Teff	3.94	341	13,435.40	4.63	10	46.26
Barely	3.93	354	13,912.20	4.61	5.6	25.84
Maize	1.18	362	4,271.60	1.39	4.4	6.1
Beans	1.21	344	4,162.40	1.42	6.4	9.09
Lents	0.48	370	1,776.00	0.56	9.6	5.41
Onion	0.57	42	2,39.40	0.67	7.8	5.22
Tea	0.02	29	5.80	0.02	0.77	0.02
Tomato	0.38	70	266.00	0.45	7	3.12
Potato	0.43	87	374.10	0.50	8	4.04
Cabage(T.Gomen)	0.12	25	30.00	0.14	2.5	0.35
Galaric	0.08	149	119.20	0.09	15.5	1.46
Berbere	0.4	318	1,272.00	0.47	23	10.80
Cooking oil	0.38	884	3,359.20	0.45	20	8.92
Coffee	0.2	2	4.00	0.23	50	11.74
Sugar	0.36	400	1,440.00	0.42	15	6.34
Beef	0.38	235	8,93.00	0.45	36	16.06
Chiken	0.18	140	252.00	0.21	24	5.07
Sorgum	0.49	347	1700.30	0.58	4	2.3
Chick peas (Shimbra)	0.16	341	545.60	0.19	7	1.32
Egg	0.01	68	6.80	0.01	25	0.29
Soybean(Dekeko)	0.07	405	283.50	0.08	9.6	0.79
Salt	0.26	0	0.00	0.03	3	0.09
			56,210.90	20.24		186.95

Source: Compute from own survey data, 2009

Annex Table 4. Graphical method of detecting heteroskedasticity consumption function



Annex Table 5: Detecting Endogeneity using Housman test

Step I: OLS regression of one explanatory variable that is susceptible to expressed by the other variable and finds the prediction of the residual of the model.

reg famsize dependence ratio head female headeduc sposeeduc head farmer headpettytrade

famsize |	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dependence~o |	.2293547	.1483814	1.55	0.124	-.0632745	.5219838
headfemale |	-1.7574	.29436	-5.97	0.000	-2.337919	-1.17688
headeduc |	.0024007	.0261932	0.09	0.927	-.049256	.0540573
sposeeduc |	-.0104598	.0283153	-0.37	0.712	-.0663016	.0453819
headfarmer |	.2419071	.4405771	0.55	0.584	-.6269732	1.110787
headpettyt~e |	.6168027	.3102257	1.99	0.048	.0049938	1.228612
_cons |	5.001999	.3402433	14.70	0.000	4.330992	5.673007

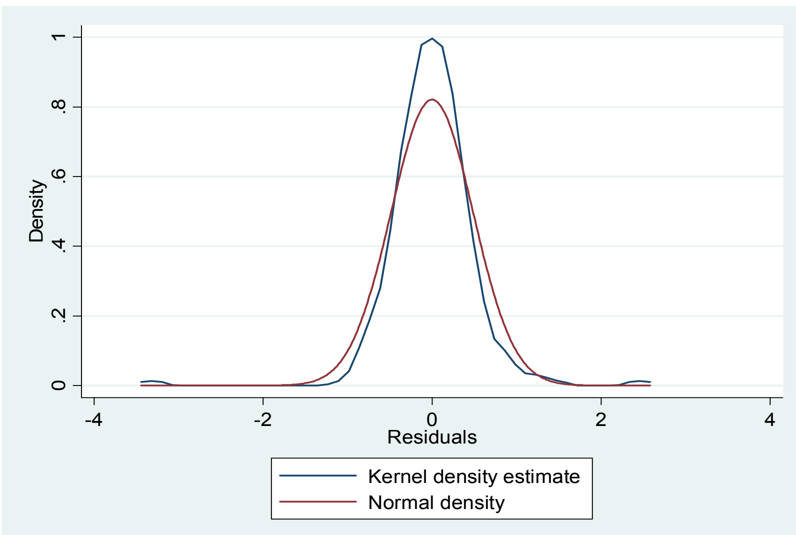
Number of obs = 203 R-squared = 0.2007
F(6, 196) = 8.20 Adj R-squared = 0.1762
Prob > F = 0.0000

Predict ress, residual

Step II. OLS regression of the consumption model against the explanatory variables including the prediction of the residual value but excluding the variable which assigned as a dependent variable in step I.

Step III: Check the t - statistics of residual value at 5% level of significance. Accordingly, the null hypothesis is accepted implied that problem of endogeneity is not prevail in the data.

Annex Table 6: Normality test using kernel density normality test



Annex Table 7: Calorie based nutrition adult equivalence scales

Years of age	Male	Female
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-30	1.04	0.80
30-60	1.00	0.82
60+	0.84	0.74

Source: Calculated from the World Health Organization (1998) by Stefan Dercon.

Annex Table 8: Definition of housing quality index, service index and Property index

An important variable in household's information for welfare measurement data is the status of residential house, service equipped to the house and possession of durable goods which attempt to measure the relative poverty status of households. The manipulation of property index is taking the mean of the eleven household durable properties like radio, sofa set, table, TV, Refrigerator, etc. Similarly, asset index is calculated by the mean of productive and livestock assets. We also include other index for instance housing quality index, and service index. For all indices, the data collection mechanism is by asking owning or not owning for the list of items and accounted by the dummy variables 1 for owning and 0 not owning. The procedure for computing these indices is as follow (adopted from Woldehanna, T. et. al, 2008)

A. The housing quality index constructs based on the following four variables:

a. The number of persons per person (continuous variable)

b. Dummy variable equal to one if the dwelling floor was made of a finished material
(such as cement, tile or a laminated material), 0 otherwise.

c. Dummy variable equal to one if the dwelling wall made from brick or plastered wall, or a sturdy roof (such as corrugated iron, tiles or concrete, 0 otherwise

d. Dummy variable equal to one if the dwelling floor is durable, 0 otherwise.
Therefore, housing quality index becomes

$$\text{A (housing quality index)} = \left[\frac{a+b+c+d}{4}\right]$$

B. Service Index calculation

a. dummy variable equal to one if the household's source of drinking water was piped into the dwelling or yard,0 otherwise.

b. dummy variable equal to one if the household had electricity, 0 otherwise.

c. dummy variable equal to one if the household had sanitation service.0 otherwise.

d. dummy variable equal to one if the household had cooking fuel, 0 otherwise.

$$\text{B (Service Index)} = \left[\frac{a+b+c+d}{4}\right]$$

C. Property index calculation

a. dummy variable equal to one if the household had radio/ tape ,0 otherwise.

b. dummy variable equal to one if the household had motor vehicle ,0 otherwise.

c. dummy variable equal to one if the household had fridge (Refrigerator),0 otherwise.
d. dummy variable equal to one if the household had Television, 0 otherwise.
e. dummy variable equal to one if the household had sofa set,0 otherwise.
f. dummy variable equal to one if the household had chair/ table ,0 otherwise.
g. dummy variable equal to one if the household had motorbike ,0 otherwise.
h. dummy variable equal to one if the household had landline phone, 0 otherwise.
i. dummy variable equal to one if the household had mobile phone, 0 otherwise.
j . dummy variable equal to one if the household had modern bed, 0 otherwise.
k. dummy variable equal to one if the household had bicycle,0 otherwise.

$$\text{C (Property index)} = \left[\frac{a+b+c+d+e+f+g+h+i+j+k}{11}\right]$$

IMPLICATIONS OF OIL PRICE SHOCKS AND SUBSIDIZING PRICES OF OIL TO THE ETHIOPIAN ECONOMY: A CGE ANALYSIS

Birouke Tefera[1], Frehiwot Fantaw[2] and Zewdu Ayalew[3]

1. Introduction

Economic growth is largely dependent on the availability of reliable sources of energy. Petroleum oil is one of the most important sources of energy integrated into the production systems of many products and in fact services (Sepheri, 2002). Hence, stability in the petroleum oil market is necessary for the normal functioning of the world economic order.

However, rising in international price oil become permanent reality attaining its climax in 2008. It was mainly driven by increasing demand from fast-growing economies such as India and China. This led to high levels of unemployment and exacerbating budget-deficit problems in oil-importing developing countries (UNCTAD, 2006). The adverse economic impact of oil price shock on oil-importing developing countries is greater than developed countries. This is because developing countries have more energy intensive and less efficient production technology. On average, developing countries consumes more than two folds amount of oil as compared to developed countries. The availability of limited alternative sources of energy also exacerbates vulnerability to oil price shocks (IEA, 2004).

Similar to other oil-importing developing countries, Ethiopia is highly vulnerable to fluctuations in world crude oil price. This study first examines the effect of crude oil price shock on major economic indicators such as domestic production, imports, household income and consumption, household savings and total investment applying the International Food Policy Research Institute's (IFPRI) standard computable general equilibrium (CGE) model. It also analyzes the likely impact of

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subsidizing oil prices on the Ethiopian economy. By doing so, the paper contributes to the empirical literature on the impact of oil price shocks and subsidies in Ethiopia. It also helps to draw some policy lessons for other developing countries with a similar structure to that of Ethiopia, specifically those with a high dependency on imported oil.

The remaining part of the paper is organized as follows. Section II reviews empirical and theoretical evidence from the literature, Section III trends in price of oil, Section IV Ethiopia's vulnerability to oil price shocks. Section IV presents the methodology and data used to estimate the impact of oil price shock on the Ethiopian economy based on Computable General Equilibrium (CGE) technique. Section V reports simulation results. Finally section VI concludes the paper.

2. Literature review

As we have seen in the second section, international price of oil has been trending higher across years. The rise in oil prices benefits oil-exporting countries as a result of high oil revenue. On contrary, it adversely affects oil importing countries though the level of the impact varies markedly depending on the degree to which they are net importers and the oil intensity of their economies (UNCTAD, 2006).

Both econometric as well as computable general equilibrium models (CGE) have been used to model the impact of oil price shocks in different countries. Vector Auto Regressive (VAR) studies have investigated the macro-economic impact of oil price shocks. Jin (2008) investigated the impact of oil price shocks and exchange rate volatility on the economic growth of Russia, Japan and China. The main findings indicate that oil price rise negatively affect economic growth in Japan and China while it affects Russia positively. Specifically, a 10 percent permanent increase in international oil prices is associated with a 5.16 percent growth in Russian GDP and a 1.07 percent decrease in Japanese GDP.

Lee and Song (2009) also found that a temporary rise in the oil price decreases both export and real GDP immediately in Korea. In addition, real GDP permanently declined by 0.5 percent. This caused by higher marginal cost from energy inputs or due to lower consumption after paying higher energy expense. Furthermore, Lee and Song came up that the price measured by CPI lowers initially but climbs steadily up. One standard deviation increases in the oil prices raise the CPI by 0.2 percent.

Another study by Hamilton (1983) found that almost all US post-war recessions appear to have been associated with increasing prices of oil. A rise of oil prices causes depreciation of the real exchange rate that makes import goods expensive in the domestic market. As a result, the demand for imported intermediate input falls and the domestic production decreases.

Gounder and Bartleet (2007) showed the causality analysis of oil price-growth nexus in New Zealand's economy. Their investigation showed the direct link between oil price shock and growth as well as the indirect linkages via inflation and real exchange rate. The unemployment effects of rising oil prices were also studied by Carruth et al (1993). As per their study higher energy costs indirectly force up unemployment.

A General equilibrium analysis of oil price shocks in different countries is also available. A CGE micro simulation analysis by Ahmed et al (2008) in Pakistan found that a 10 percent increase in the import price of petroleum brings about a 0.7 percent decline in GDP value added. Private consumption declines by 4.3 percent. As a percentage of nominal GDP, investment and private savings increased by 1.1 percent. Current account deficit as percentage of nominal GDP also increases by 0.2 percent. The overall import price index increases by about 11.9 percent. Given that the trade deficit to nominal GDP ratio increases by 0.2 percent, there is an impact on tariff revenue and government savings, both decreasing by 0.2 and 0.3 percent respectively. They found that the impact that increases in import price of petroleum is greater than any other commodity groups due to the intensity with which this good is used in the production process (as well as by the households), and the knock-on effects that petroleum prices have at the macro as well as micro level.

Fofana et al (2009) studied the economy of South Africa using an energy focused Macro - micro CGE model. A sustained 100 percent price rise of oil was experimented under alternative scenarios. The model predicts that GDP would fall by between 2.2 and 2.5 percent under the two scenarios. In the first scenario, the rise in the international price of oil and petroleum products is fully transmitted to end users (floating price scenario). The second scenario assumed full compensation of the welfare loss through subsidy (fixed price scenario). A key driver of these results is the exchange rate effect. The exchange rate depreciates more in the fixed price relative to the floating price scenarios leading to a fall in the average domestic prices by 3.4 percent and 2.6 percent, respectively. The impact on the government deficit varies widely among the scenarios, ranging from a worsening of 12 to 22 percent in the floating prices and the fixed price scenarios, respectively. Unemployment increases among medium and low skilled workers. Poverty headcount ratio increases by 1 percent when the imported crude oil and oil products prices rise by 50 and 25 percent respectively. The poorest households are most adversely affected by the increase of oil prices.

McDonald and Van Schoor (2005) in South Africa also found a 20 per cent increase in oil prices results in a drop in GDP of 1 per cent. It is found that the major impact is to be found in the petroleum industry itself, whereas the effects on liquid fuel dependent industries such as transport is not as large as may be supposed. In agriculture, it is found that the depreciating currency has a positive effect, offsetting most of the negative effects of higher petroleum prices, particularly in export-oriented areas. In a long-term scenario, capital and skilled labor becomes mobile, and the results suggest that such reallocation may not be to the overall advantage of the economy.

Applying CGE model Al-Amin et al (2008) in Malaysia found that an imported crude oil price shock cause household income, household consumption and household savings to decline. In addition, real GDP declines, while the resulting drop in government revenue has a significant negative impact on investment and fixed capital formation. Specifically, the model results indicate that a 15 percent crude oil price shocks, decreases the domestic production of building and construction sector by 25.87 percent, hotels, restaurants and entertainment sector by 12.04 percent, industry sector by 12.02 percent, agriculture sector by 11.01 percent, and electricity and gas sector by 9.55 percent. On the import side, imports decreases significantly in all sectors from base level. The largest negative impacts goes on industry sectors by 29.67 percent followed by building and construction sector by 22.42 percent, hotels, restaurants and entertainment sector by 19.45 percent, electricity and gas sector by 13 percent, agriculture sector by 12.63 percent and other service sectors by 11.17 percent.

In the case of Ethiopia, Fekadu (2005) assessed the impact of oil price increase in the Ethiopian Economy using trend and econometric analysis. He found that oil price increase has a significant impact on the core inflation while it is minimal in the general inflation in the short run. He concluded that non-food price index is relatively more sensitive to the oil price increase.

A CGE analysis by Ahmed (2007) found that oil price shocks deteriorate absorption, consumption and investment and the depreciation of the exchange rate in the Ethiopian economy. In addition, he found that progressive increase in oil prices cuts household consumption reducing real per worker income of households. He also found that subsidizing the oil market generates a structural adjustment problem in Ethiopia. Increasing cost of subsidies also absorbs an increasing share of the scarce public resources thus adversely affecting the public investment.

As a copping strategy for oil price increase, price subsidies and petroleum product tax reduction are the two most commonly used methods of partially offsetting higher oil prices in the international market. In recent years, the amount of subsidies carried by different governments is very large to mitigating adverse effects on poor households. Ethiopia spent more than 7.7 billion birr ($794 million) on fuel subsidies to stabilize the oil market between August 2006 and January 2008 (World Bank, 2009).

Fuel subsidies in Indonesia tend to be highly regressive and inefficient in targeting the poor, undermine macroeconomic stability, hinder competitiveness, distort price signals to industry and households, reduce fiscal space and generate opportunities for corruption and smuggling (World Bank, 2008). A distributional effect of oil subsidy is observed in Mali. While subsidy is targeting the poor, high-income households benefit disproportionately from oil price subsidies. Thus the petroleum price subsidies are ineffective in protecting the income of poor households compared with a targeted subsidy (Kpodar, 2006).

3. Trends in international and domestic price of oil

International crude oil price has been rising year to year. It rose by 28 percent in July 2006, 38 percent in July 2007, 153 percent July 2008 and 23 percent in July 2009 as compared to July 2005. In the same way, the year-on-year percentage change sharply rose by about 7 percent, 86 percent and 51 percent in July 2007, July 2008 and July 2009, respectively (see Figure 1 below).

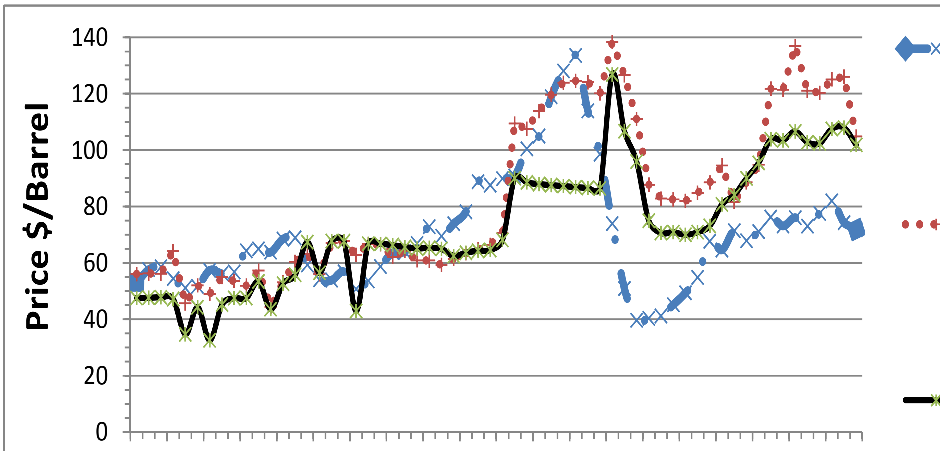
The international price of crude oil went up sharply between March and August 2008 because of high world demand as a result of strong economic growth in China and India, commodity price speculations and OPEC monopoly pricing. The time lags and geological limitations to increase production also stagnated supply resulting in tightening the balance of supply and demand, (Hamilton, 2008; Behr, 2009). August 2008 onwards, it started declining until May 2009 due to low demand as a result of the global financial crisis[4], (Schubert, 2009). However, it again started rising since June 2009 from its lowest level of the past five months and varies in between 65 to 85 Dollars per barrel.

The international oil price hike has also repercussions on the Ethiopian economy pushing average domestic wholesale oil products price up from 56.07 Dollar per barrel in July 2005 to 126.05 Dollar per barrel in May 2008. A close examination of Figure 1 below reveals that the international and domestic price of oil has a strong correlation in that the two prices moves together. Until the end of August 2008, the

[4] http://www.un.org/esa/policy/wess/wesp2010files/chap2.pdf, http://www. omrpublic.iea.org/omrarchive/12augo8full.pdf

gap between domestic and international price was very minimal since the government has been subsidizing oil prices. From September 2008 onwards however, the government suspended oil price subsidy scheme resulting in widening of the gap between international and domestic price of oil. It was again precipitated by the decline in the foreign exchange value of the birr from the end of 2008 onwards.

Figure 1:- Trends in the percentage of oil imports to GDP and to the total imports from 1999/00 – 2007/08 (Percentage Change).



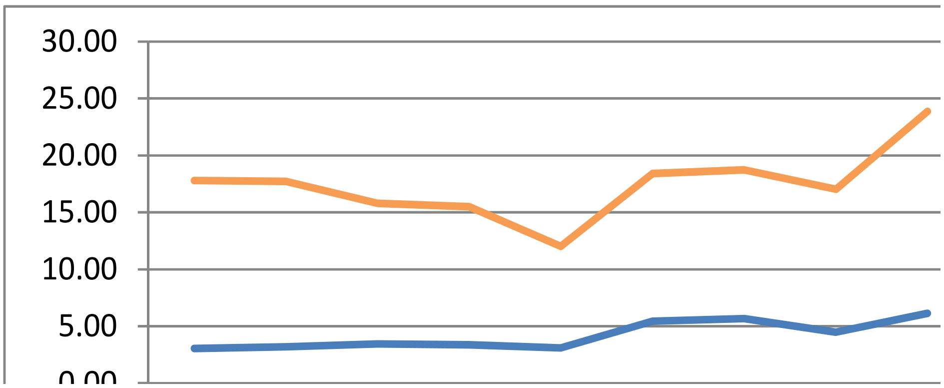
Source: - International Energy Agency (IEA) energy statistics database and Ethiopian Petroleum Enterprise (EPE)

Even though the price of oil increases over time, Ethiopia's volume of import for petroleum products continued rising significantly each year on average by 10 percent between 2004/05 – 2008/09. In value terms, import rose by 67.89 percent, 34.28 percent, 18.07 percent, 90.65 percent, in 2004/05, 2005/06, 2006/07 and 2007/08 fiscal year, respectively. The reason for this large rise in value of imports was the persistent rise in international oil prices. On the contrary, the value of import for the 2008/09 fiscal year fell by 14.85 percent due to a continuous drop in the international price of crude oil[5].

Furthermore, the share of oil import to the total GDP showed an upward trend over time except some drop In 2003/04 and 2005/06 fiscal year as illustrated in Figure 2 below. The share of oil import to the total import is significantly higher and fluctuating within the range of 15 to 24 percent between 1999/00 to 2007/08 fiscal year.

[5]National Bank of Ethiopia Annual Reports (NBE), 2004/05 – 2008/09.

Figure 2:- Trends in the percentage of oil imports to GDP and to the total imports



Source: National Bank of Ethiopia (NBE) and Ministry of Finance and Economic Development (MOFED)

4. Ethiopia's vulnerability to oil price shocks

Nowadays, high oil price is the permanent reality of the world. A persistent rise in oil price in the international market pushes domestic prices up. It also shifts the terms of trade in favor of oil exporting countries through a transfer of income from Ethiopia. Rise in oil price drain more of the country's foreign exchange (about USD 192 million, in 2004/05 for example) than anticipated[6]. This implies Ethiopia is at the sharp edge of oil price shock and hence highly vulnerable to it.

The study estimated the vulnerability of Ethiopia to oil price shocks following the methodology of Bacon and Mattar (2005) as shown in Table 1 below. A major factor that explains high oil vulnerability is the complete reliance of Ethiopia on imported oil. Furthermore, the share of oil in the total energy mix (oil energy dependence) also remains high above 65 percent though it declined from 72 percent in 2003 to 66 percent in 2009.

Consumers and energy using producers has little flexibility to reduce oil consumption or find other options immediately after price changes since technology is fixed in the short run. Close to 80 percent of the imported oil is consumed by the construction sector, Wholesale and retail trade and repair of motor vehicles, motorcycles and

[6] National Bank of Ethiopia annual Report.

personal and households and urban as well as rural households[7]. As a result, these groups of oil users suffer the worst from oil price shocks.

The availability of alternative energy substitutes also matter to cope up oil price shocks. However, energy substitutes are hardly available in Ethiopia. Recently, Ethiopia started bio-fuel production and the massive expansion of the hydropower. Electricity production has grown, on average, by 10 percent per year between the 2003/04 – 2008/09 fiscal years. Import volume of petroleum products also increased by almost the same rate[8]. It seems there is no substitutability rather both energy sources go together to fulfilling the domestic demand for energy.

At the household level, fuel switching to the use of ethanol and the promotion of stove efficiency improvements by disseminating improved stoves is under promotion. The application of such types of technologies may increase efficiency and reduce oil vulnerability. It has also a potential of reducing the risks of environmental pollution.

Furthermore, experts in the area recommended the transport sector to use hybrid vehicles with low fuel consumption, taking fuel wasting vehicles off the road, and the use of alternative mass transportation such as electric trains, promoting use of mass transportation and the use of non motorized transport (MOWR, 2007; Bekele Bayisa, 2007). However, the recommendations are not implemented as we daily encounter such fuel inefficient old cars emitting dark, cloudy and polluting smokes everywhere in the country.

Table 1: Estimated vulnerability of Ethiopia to oil price shocks

Measures	2003	2004	2005	2006	2007	2008	2009
Oil Import Dependence	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oil Energy Dependence	0.72	0.71	0.69	0.69	0.69	0.72	0.66
Total Energy Intensity	8071.96	6912.15	5991.35	5211.22	3849.87	3263.50	3548.74
Oil Intensity	5788.04	4911.76	4156.65	3610.17	2673.44	2358.20	2333.26

Source: - Authors computation from International Energy Agency (IEA) database.

Note:- *Oil Intensity = Oil consumption in BTU[9] per GDP in dollars.*
Total energy intensity = total primary energy consumption in BTU/GDP in dollars.
Oil energy dependence = oil consumption in BTU/Total primary energy consumption in BTU.
*Estimated vulnerability = (net oil imports*average price of crude oil in dollars)/GDP in dollars.*
Oil import dependence = net oil imports/total oil consumption.
Qbtu stands for quadrillion Btu.

[7] Ethiopian Development Research Institute (EDRI) ,2005/06 SAM.
[8] National Bank of Ethiopia annual reports various issues'.
[9] A BTU, an abbreviation for British thermal unit, is equivalent to 252 calories and serves as the base unit for measuring the heat content of a fuel source.

5. The model, macro-economic closures and the simulations

5.1 The model and closure rules

This paper uses the standard IFPRI static CGE model using 2005/06 Ethiopian SAM. The SAM is disaggregated in 99 activity, 91 commodity, 25 factor, 14 household, 17 tax (8 indirect commodity taxes and 9 direct taxes) accounts. However, for the purpose of this study the SAM is aggregated into 15 activity and commodity, 4 factor, 4 household, and 3 tax accounts. The SAM also has government, saving-investment, inventory and rest of the world accounts.

The standard CGE model explains all of the payments and receipt recorded in the SAM. The model follows the SAM disaggregation of factors, activities, commodities, and institutions. It is written as a set of simultaneous linear and nonlinear equations. The equations define the behavior of the different actors. Some of these behaviors follow simple rules captured by fixed coefficients (ex. Ad valorum tax rates). For production and consumption decisions, behavior is captured by nonlinear first-order optimality conditions. Production decisions are driven by the maximization of profits subject to costs of factors and intermediate inputs. Consumers maximize their utility subject to the budget constraints. The equations also include a set of constraints that have to be satisfied by the system as a whole but are not necessarily considered by any individual actor. These constraints cover factor and commodity markets. Furthermore, the equations has also macroeconomic balances for saving and Investment, the government, and the current account of the rest of the world (Löfgren et al, 2002).

The behavior of major economic agents such as savers, investors, the government, and the rest of the world behave has to be clearly specified in order to close the model. Therefore, the closure rules determine how the macro economy and the factor markets work. For this paper, government savings are flexible; direct tax rate is fixed implying the government finances its budget deficit through borrowing and constrained in raising taxes to cover additional public spending. Savings-driven investment closure is adopted in which investment adjusts endogenously to the availability of loan able funds. The level of foreign savings is fixed and exchange rate is flexible. The implication of this closure is that during shortage of foreign savings the real exchange rate adjusts by simultaneously reducing spending on imports and increasing earnings from export. Furthermore, land and capital is fully employed & activity-specific while labor is assumed to be fully employed and mobile across.

5.2 Simulations

This paper uses two alternative scenarios. The first scenario assumes 50 percent rise of international petroleum price and this price change is fully transmitted to end users (consumers and producers) through an increase in purchasing prices of petroleum products. The 50 percent shock is not arbitrarily chosen rather it is based on the trends of international oil prices. Moreover, the elimination of fuel price subsidies by the Ethiopian government in October 2008, resulting in a price increase of 50 percent for kerosene and 40 percent for diesel (World Bank, 2009). In addition, average international crude oil price increase by more than 50 percent in 2008 as compared to the year 2007. As a result, we simulate the C.I.F import price in foreign currency units (pwm_c) assuming 50 percent increase in international price of oil as shown in the following equation.

$$PM_c = pwm_c * (1 + tm_c) * EXR + \sum_{c' \in CT} PQ_{c'} * icm_{c'c}$$

Where PM_c = import price in local currency units including transaction costs,

pwm_c =C.I.F import price in foreign currency units,

tm_c = import tariff rate,

EXR = exchange rate local currency unit per foreign currency units,

$icm_{c'c}$ = quantity of commodity C as trade input per imported unit of C,

$\sum_{c' \in CT} PQ_{c'} * icm_{c'c}$ = cost of trade inputs per import unit,

C = a set of commodities and

c = a set of imported commodities.

The second scenario assumes what happens if the government subsidizes the international oil price increase to compensate consumers loss from higher price of fuels. The subsidy is used to compensate for the 50 percent increase in crude oil price through a reduction of domestic sales tax on fuel. The rate of domestic sales tax (tq_c) to keep consumers at welfare level as equal as before the oil price shock happens is equal to -0.378. This rate (tq_c) is calculated keeping domestic selling price (PQ_C) unchanged (i.e. constant at the amount it was before the world price shock), and import price changing accordingly. Since Ethiopia is net fuel importer (the local manufactured fuel became zero) we take the composite commodity price.

$$PQ_c * (1 - tq_c) * QQ_c = PDD_c * QD_c + PM_c * QM_c$$

Where PQ_c =domestic sales price (price of composite goods),
PDD_c = demand price for commodity produced and sold domestically,
PM_c = import price in LCU (local-currency units) including transaction costs,
QQ_c = quantity of goods supplied to domestic market (composite supply),
QD_c = quantity sold domestically of domestic output,
QM_c = quantity of imports of commodity, and
tq_c = rate of sales tax (as share of composite price inclusive of sales tax).

6. Results

6.1 Macro effects of the oil price shock

Scenario one: - It is assumed that a 50 percent rise in imported crude oil price is fully transmitted to end users (consumers and producers) through an increase in purchasing prices of petroleum products.

The immediate effect of oil price increase is through its effect on increasing prices of tradable commodities. On average, the price of tradable commodities increases by 5.19 percent from the baseline. The price increase induces the import bill to rise which in turn results in foreign exchange shortage since the demand for oil import is price inelastic. As a result, real exchange rate depreciates by 5.8 percent. The depreciation of the real exchange rate encourages exports to increase by 5.34 percent and real imports in base year prices fall by 3.83 percent. The oil price shock decrease total absorption by 1.84 percent, private consumption by 1.7 percent and fixed investment by 3.65 percent as shown in Table 2 below.

Table 2:- Percentage changes in the impact of oil price increase and oil subsidy in macro variables.

Macro Accounts	Government Savings are Flexible		Government Savings are Fixed	
	Increase in Oil Price (percent)	Oil Subsidy (percent)	Increase in Oil Price (percent)	Oil Subsidy (percent)
Real effective exchange rate	5.8	6.4	5.8	6.9
Nominal effective exchange rate	2	2.7	2.1	3.2
Investment as a percent of GDP	0.3	(1.6)	0.4	0.5
Private saving as a percent of GDP	-	0.3	-	0.1
Foreign saving as a percent of GDP	0.3	0.4	0.3	0.5
Government saving as a percent of GDP	-	(2.2)	0.1	0.1
Absorption	(1.84)[10]	(1.94)	(1.9)	(2.0)
Private consumption	(1.70)	(0.63)	(1.8)	(2.4)
Fixed investment	(3.65)	(8.63)	(3.5)	(1.3)
Exports	5.34	5.28	5.4	7.2
Imports	(3.83)	(4.01)	(3.8)	(3.5)
GDP at factor cost	(0.01)	(0.03)	(0.008)	(0.004)

Source: - authors computation
Note: - figures in brackets are negative values

6.1.1 Impact of the shock in level of domestic activities and labor demand

The oil price shock causes a ‘contractionary’ effect on output of the manufacturing and the service sectors. Output of the construction sector affected significantly; fell by about 3.38 percent, the manufacture of furniture, manufacture of jewellery and related articles (aoman) decline by about 1.83 percent, the Manufacture of chemicals, rubber and plastic products (achem) sector by about 1.74 percent and the food processing sector output decrease by about 1.22 percent. The least affected sector is the financial services, real estates and other services (apsrv) sector which fell by 0.01 percent.

Alike the export tradable, the oil price shock increases the output of the manufacture of ovens, furnaces and furnace burners and the manufacture of machinery for food, beverage and tobacco processing (amach) sector by 1.03 percent perhaps because it uses a small fraction of oil as an intermediate input (only 0.15 percent). The depreciation of the real exchange rate encourages agricultural tradable goods so that output rises on average by 0.81 percent. However, output of *teff* production has declined by about 0.25 percent because farmers may shift their production to exportable crops. As a consequence of the decline in output, labor demand for the manufacturing and service sectors fall extremely affecting the construction sector record the highest decline by about 12.61 percent (see Table 3 below).

Table 3:- Percentage changes in the impact of oil price increase and oil subsidy in level of domestic activities

Activities	Government Savings are Flexible		Government Savings are Fixed	
	Oil Price Increase (percent)	Oil Subsidy (percent)	Oil Price Increase (percent)	Oil Subsidy (percent)
Production of Teff(ateff)	(0.25)	(0.18)	(0.3)	(1.1)
Production of Maize and Wheat(amzwh)	0.11	0.22	0.1	(1.2)
Non-traded agriculture (antag)	0.42	0.25	0.4	(0.5)
Export crops (axcrp)	2.22	1.64	2.2	1.8
Livestock (alive)	0.55	0.41	0.5	(0.3)
Food processing (afood)	(1.22)	0.15	(1.2)	(0.4)
Chemical production (achem)	(1.74)	1.18	(1.7)	1.3
Machinery and vehicles (amach)	1.03	0.69	1.1	1.5
Other manufacturing (aoman)	(1.83)	0.91	(1.8)	2.2
Construction (acons)	(3.38)	(7.67)	(3.2)	(1.1)
Electricity and water (autil)	(0.76)	(0.35)	(0.8)	(0.4)
Trade and transport (atrad)	(0.43)	0.38	(0.4)	0.6
Trade and transports (apsrv)	(0.01)	0.10	0.0	0.0
Government services (agsrv)	(0.08)	0.03	(0.1)	(0.1)

Source: - authors computation

Note: - figures in brackets are negative values

Repeating the same scenario with the alternative government closure, i.e., government savings are fixed, exhibits nearly no difference in most of the macro variables and level of domestic activities.

6.2 Macro effects of oil subsidy scheme

Scenario two: The second scenario assumes the government compensates domestic consumers for the price rise through oil subsidy. The subsidy is used to compensate for the 50 percent increase in crude oil price and is modeled as a reduction in domestic sales tax on petroleum products.

As a result, the oil price shock still persists and the subsidy scheme leads to a 5.87 percent increase in prices of imported commodities in the domestic market. The real exchange rate further depreciates by 6.4 percent leading to a rise in export by 5.28 percent, a bit less than the rise in the first scenario. Real imports further decline by 4.01 percent. The oil subsidy scheme reduces government savings so that fixed investment decline by 8.63 percent. Private consumption improves. However, the increase in private consumption is at the expense of lower level of fixed investment. It further declines as compared to the first scenario.

Table 4:- Percentage changes in the impact of oil price increase and oil subsidy to labor demand.

Activities	Government Savings are Flexible		Government Savings are Fixed	
	Oil Price Increase (percent)	Oil Subsidy (percent)	Oil Price Increase (percent)	Oil Subsidy (percent)
Production of Teff(ateff)	(0.30)	(0.22)	(0.33)	(1.3)
Production of Maize and Wheat(amzwh)	0.13	0.26	0.09	(1.45)
Non-traded agriculture(antag)	0.51	0.30	0.48	(0.62)
Export crops (axcrp)	3.49	2.57	3.5	2.9
Livestock (alive)	0.80	0.60	0.77	(0.44)
Food processing (afood)	(3.40)	0.42	(3.44)	(1.0)
Chemical production (achem)	(5.93)	4.20	(5.93)	4.52
Machinery and vehicles (amach)	3.99	2.63	4.07	5.71
Other manufacturing (aoman)	(3.52)	1.77	(3.45)	4.38
Construction (acons)	(12.61)	(27.42)	(11.98)	(4.26)
Electricity and water (autil)	(2.61)	(1.21)	(2.61)	(1.26)
Trade and transport (atrad)	(2.03)	1.81	(2.0)	2.93
Trade and transports (apsrv)	(0.05)	0.68	(0.08)	(0.24)
Government services (agsrv)	(0.21)	0.08	(0.22)	(0.16)

Note: - figures in brackets are negative values
Source: Authors computation

6.2.1 The impact of oil subsidy on the level of domestic activities and labor demand

The oil subsidy scheme brings improvement in output of the manufacturing and service sectors except for the construction sector. Output of construction sector declines further since high proportion of the investment spending goes to this sector. On average, production of the agricultural tradable goods, rise by 0.63 percent at a little lower rate than the rise in the first scenario. In addition, the labors demand for all sectors of production increase but not to the construction sector. The construction sector labor demand falls by more than two folds as compared to the first scenario.

6.2.2 The impact of oil price shock and oil subsidy on household consumption

The 2005/06 Ethiopian SAM data showed that both rural and urban non-poor households have the largest share in oil consumption relative to poor households which implies the effect of oil price shock is high on rural and urban non-poor households compared with their respective poor households. Due to the oil price shock the consumption of rural and urban non-poor households dropped by 2.1 percent and 1.3 percent respectively. Rural and urban poor households consume a small share of oil and they are the least affected only by 0.9 and 1.69 percent respectively.

When the government subsidizes oil prices through borrowing, the oil price subsidy scheme improves the consumption of all households. The rural and urban non-poor households benefited more by the oil subsidy compared with their poor counterparts as shown in the Table 5.

Replicating the same experiment with alternative government closure, government savings are fixed; where the government subsidizes oil price through taxation shows substantially different result in the macro variables, level of domestic production, labor demand and household consumption.

Compared with the previous government closure, in the current government closure the level of exports largely increased on account of a further depreciation in real exchange rate. Since the oil subsidy scheme is financed through direct tax revenue it doesn’t affect the government saving rather improvement in investment as a percentage of GDP and fixed investment as the expense of decline in private consumption is observed.

Table 5: Percentage changes in the impact of oil price increase and oil subsidy to household consumption.

Households	Government Savings are Flexible			Government Savings are Fixed			Share of oil consumption in 2005/06
	Sim 1	Sim 2		Sim 1	Sim 2		
	Oil Price increase (percent)	Oil subsidy (percent)	Sim 1 vs.sim 2(percent)	Oil Price increase (percent)	Oil subsidy (percent)	Sim 1 s.sim 2(percent)	
Rural poor	-1.68	0.28	1.99	-1.74	-1.97	-0.24	10.49%
Rural non poor	-2.09	0.04	2.18	-2.15	-2.22	-0.08	46.28%
Urban poor	-0.91	0.76	1.69	-0.97	-1.19	-0.23	6.27%
Urban non poor	-1.25	0.55	1.82	-1.30	-1.49	-0.19	36.95%

Source: - authors computation

The new subsidy scheme deteriorates the level of output and labor demand of almost all agricultural activities. While it improves the manufacturing sector output and labor demand with the exception of

The subsidy scheme deteriorates the households' welfare further since it has double burden, i.e. decrease their disposable income and level of oil consumption. Compared with the non-poor households poor households found to be more vulnerable to the subsidy scheme.

7. Conclusions

International crude oil price has increased for the last two decades. Oil importing countries like Ethiopia is seriously affected by this price hike. Ethiopia is highly vulnerable to this shock because of its high oil energy intensity and complete dependence on imported oil. This paper attempted to analyze the impact of a 50 percent increase in international oil prices and oil subsidy scheme to compensate this increase in crude oil prices using the standard IFPRI's static CGE model. The oil price shock causes a 5.8 percent depreciation of the real exchange rate and brings about an increase in exports & decline in imports. The depreciation of the birr also brings a rise in agricultural tradable goods output and a decline in manufacturing and service sectors output. The shock also deteriorates income and consumption of all households'. In general, rural households are most negatively affected by the oil price shock as compared to urban households.

The rising oil prices in the international market are affecting the Ethiopian economy. It affects the balance of payments (BOP) and on domestic prices through various channels. Higher fuel prices soars food prices reducing the purchasing power of the birr in turn affecting the welfare of households since fuel and food are core elements of household budgets in Ethiopia.

The oil subsidy scheme increases government expenditure and reduces government savings hence total investment falls. Output of the construction sector goes down because of the fall in investment demand. The oil subsidy improves consumption to all households. Urban households get the largest benefits in part because urban households consume more fuel than rural households do. However, comparing the two scenarios rural households benefit from the oil subsidy scheme. In the short run, the oil price subsidy scheme improves household welfare. Nevertheless, in the long run oil subsidy is harmful since it absorbs high share of limited public resources, leads to lower investment and reduces future growth.

Financing oil subsidy scheme by maintaining government savings brings improvement in investment but it distorts the level of domestic production and household welfare. From this one conclude that subsidy is an inefficient tool to reverse high oil price increase in developing countries. Rather finding ways to substitute oil for other energy sources would be a remedy.

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INTERNATIONAL MIGRATION, REMITTANCES AND POVERTY ALLEVIATION IN ETHIOPIA[1]

Emerta Asaminew, Getachew Ahmed, Kassahun Aberra and Tewodros Mekonnen[2]

Abstract

The paper explores the impact of international remittances on the Ethiopian economy and on the livelihoods and welfare of households. A simple dynamic econometric model, Vector Autoregressive (VAR) model, was used to see the impact of international remittances on absorption, spending and output. Moreover, we used binary outcome model to test whether remittances have an impact on the welfare of households. It uses macroeconomic data and data from the Ethiopian urban household survey.

It was found that remittance shocks positively affect macroeconomic variables; the effect remained to be volatile in the very first periods after the shock. However, the impacts tend to sustain in the years after the fifth period. Moreover, through the positive (but inelastic) relationship between growth and poverty, private remittance inflows have an important implication on poverty in Ethiopia. International remittances significantly reduced the poverty incidence among the urban households in the country. It was also found that female-headed households are more likely to use remittance more effectively than male-headed households are.

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1. Introduction

Migration refers to a change of the usual place of dwelling in permanent or temporarily basis (Arsole et al, 2003 in Adamnesh, 2008) either voluntary or forced (Kokpari, 2000). People migrate to take advantage of opportunities in host countries such as economic, social, political, and environmental or a combination of all. The tempting wage gaps between developed and developing countries, inviting immigration programs in the developed world, lack of democracy and good governance in the home countries, and poverty and environmental degradation in the home countries are some of the factors for international migration (Portes,1996).

Recent estimates shows nearly 200 million people live outside their country of birth. According to the United Nations estimates between 1960 and 2005 the number of international migrants doubled passing from an estimated 75 million in 1960 to almost 191 million in 2005 (UN, 2006).

Migration has diverse socio-economic impact ranging from increasing better opportunities for the migrant to an improved livelihood of sending households and to contributing economic growth. Remittances [from migrant workers] have reduced the share of poor people in the population by 11 percent in Uganda, 6 percent in Bangladesh and 5 percent in Ghana. Remittance income is also associated with higher school attendance in the Philippines, improved health outcomes in Guatemala and increased investment in microenterprises in Mexico (World Bank, 2006).

Ethiopia is challenged by different migration patterns and dynamics, which have significant political and socio-economic ramifications for the country. The country has one of the highest African diaspora populations, which undoubtedly affects the government’s sustainable development and poverty reduction programs. According to Dejene (2005), international migration is increasing starting from the late 1970’s, which is the result of the political instability at that time. Nowadays, many Ethiopians, skilled and unskilled, cross border to different countries legally and illegally looking for better economic opportunities. The main destinations for Ethiopians are North America, Europe, and the Middle East (Dejene, 2005).

Acording to the National Bank of Ethiopia’s reports , the inward private individual transfers have grown tenfold from a meager USD 177 million in 2000/01 to USD 1.8 billion in 2008/09 surpassing foreign exchange earnings from FDI and export. This suggests that immigrant remittances are an important part of the Ethiopian economy and welbeings of Ethiopian households.

However, while migration originating from relatively poor to rich countries is well known, very little is known about the role of remittances they send back home on poverty reduction. The remittances the diaspora send to their home country constitute a large amount of foreign exchange used for poverty alleviation at the household level. It also adds to the stock of international foreign exchange reserve of the country leading to macroeconomic impact such as economic growth. The objective of this study is to see the livelihood consequences of these remittances on the welfare of households and the macroeconomic impact of inflows of international migrant remittances on poverty reduction.

The rest of this document is organized as follows. A review of migration patterns and international remittances will be made in the second section. We devoted two separate sections for our analysis of results. We do this because of the different impact remittances have at the household level and on the economy at large. As a result, we employed two different data sets and methodological approaches. While the macroeconomic impact, on the Ethiopian economy, of international remittance, is discussed in the third section, the fourth section deals with livelihood consequences of migration and its concomitant inflow of remittances on the welfare of households. The fifth section concludes.

2. Patterns of international migration and remittances

Generally, international migration flows from less developed to industrial countries. The number of migrants continued increasing in recent years. However, the share of Africa has dropped from 12% in 1970 to 9% in 2000. This is not because the absolute number of African migrants decreased, but the share of most populous countries such as China, India and the Philippines outnumber Africa in recent years. International migration is concentrated in few countries. By the end of 2005, 12% of countries globally hold 75% of migrant stocks (WB, 2005).

The 2005 International Migration Report indicated that Australia, North America, Europe, Africa and Latin America host 18.7%, 12.9%, 7.7%, 2% and 1.4% of the world's migrant stock, respectively. The three top migrant receiving countries are United States, Russia and Germany accepting 35 million, 13.3 million and 7.3 million migrants respectively. On the other hand, China, India and the Philippines are the three most migrant sending countries with 35 million, 20 million and 7 million people. While Mexico, India, the Philippines and Egypt received USD 11 billion, 8.4 billion, 7.4 billion and 2.8 billion respectively from remittance receipts, USA, Saudi Arabia, and Germany remit USD 28 billion, 15 billion and 8 billion, respectively.

Migration has a mixed effect on the sending and receiving countries. United States of America is the leading beneficiary of migration as it is populated by immigrants and their descendants. In addition to being source of foreign exchange, migration might also have potential benefit to home countries as it may ease population pressure in developing countries, and reduce unemployment problem in developing countries.

This argument is, however, controversial as most of the emigrants from developing countries are qualified and potential entrepreneurs. Thus, migration may exacerbate the unemployment problem of the host country instead of lessening it. Furthermore, since most of the migrants are economically active, it may jeopardize the long term development effort of sending countries by drawing out the economically active segment of the society. Migration is, therefore, a costly experience for sending countries as lots of their most valuable medical doctors; engineers, accountants etc. left their home countries after they invested lots of resources to educate them (Siliji, 2001).

2.1 Ethiopia's international migration patterns

Ethiopia is one of the countries with a large number of migrants in North America, Europe and the Middle East. According to Teferi and Beruk (2009), by the end of 2005, more than 1 million Ethiopians migrated to the rest of the world. Looking for a better education, employment opportunities, and political instability are considered major causes for migration. Political migration was intensified in Ethiopia during 1970-1990 due to political instability at the time. Although the stock of migrants is decreasing since 1990, migration is still important and a hot issue in the current day Ethiopia.

The UN 2008 Revised Population Database shows that 546,000 Ethiopian migrants live in different parts of the world. This estimate is, however, understated vis-à-vis the Ministry of Foreign Affairs of Ethiopia estimates which sometimes reach as big as 1.5 million (Teferi and Beruk 2009). According to the Population and Housing Census conducted in 2007, Ethiopia's population grew by about 2 million people. At the same time, close to 120 thousand Ethiopian left their country every year.

Political and economic reasons accounted for the increase of Ethiopian migrants since the 1970s. But, these are by no means the only reasons. According to Abye (2008), some migrants come from a well to do family who can afford the travel and living expenses abroad. Those who are facing hardship at home are not those who migrate because the poor can't afford to travel. Hence, it can be argued that although the initial reason of migration is political instability, the recent migration trend can be accounted for by the desire to acquire western culture and enjoy better standard of living. This, however, does not include those who migrate to the Middle East whose case is mostly economic. According to Adamnesh (2006), survey on Ethiopian returnee shows a search for education in host country, political instability at home and better standard of living in host country accounted for 54%, 27% and 10% respectively of the respondents.

Table 1: Ethiopia's migrant stock from 1970-2010 (thousands of people)

Indicator	1970	1975	1980	1985	1990	1995	2000	2005	2010
Estimated number of international migrants at mid-year	395	392	404	584	1,155	795	662	554	548
Estimated number of refugees at mid-year	21	9	11	180	42	371	228	108	91
Population at mid-year (thousands)	30	34	37	43	48	57	66	75	85
Estimated number of female migrants at mid-year	171	175	184	268	548	376	312	261	258
Estimated number of male migrants at mid-year	223	217	220	315	607	419	351	293	290
International migrants as a percentage of the population	1.3	1.1	1.1	1.3	2.4	1.4	1	0.7	0.6
Female migrants as percentage of all international migrants	43.4	44.7	45.5	46	47.4	47.3	47.1	47.1	47.1
Refugees as a percentage of international migrants	5.2	2.2	2.7	30.9	64.2	46.7	34.4	19.6	16.6

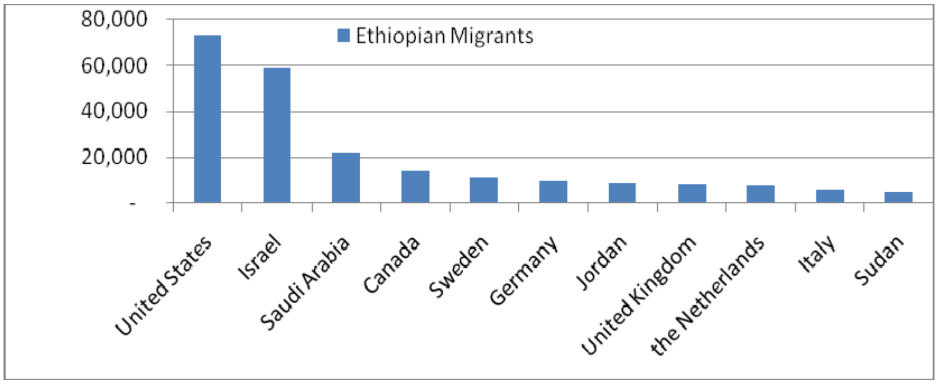
Source: UN (2006).

According to Bathsheba (2007), Ethiopia lost 74.6% of its skilled manpower during the period 1980-1991. By end 2002, Ethiopia lost more than one third of medical doctors. However, during the 1980-1991 periods, only 25% of those who had gone for further studies returned. Moreover, according to Abye (2008), out of the 5000 PhD holders and 5000-6000 MDs the country has produced during the last 100 years, over 30% live and work abroad. As a result, the country spends about USD 5.3 million per annum on expatriate professionals to fill its human resource gap.

People migrate from Ethiopia mainly through family ties, networks, labor brokers, smugglers and traffickers. Business meetings and conferences are also becoming a major source of migration in Ethiopia. Young women are the main victims of traffickers in Ethiopia. According to Adamnesh (2006), 14,000 Ethiopian women were domestic workers in Beirut and 17,000 in Lebanon. But official data shows only 6,148 women left the country legally during 1992-2001. This shows that a significant number of Ethiopian women go through illegal channels. Some women also move to

Saudi Arabia and other Arab states through Oumra and Hajji. On the other hand, the major channel that people migrate to U SA is via diversity visa (DV) lottery.

Figure 1: Number of Ethiopian Migrants by country of residence, circa 2000



Source: Migration Policy Institute quoted in Adamnesh (2008)

Figure 1 shows the top eleven destinations of Ethiopian migrants are: United States, Israel, Saudi Arabia, Canada, Sweden, Germany, Jordan, UK, Netherlands, Italy and Sudan.

Recent data obtained from the Ministry of Foreign Affairs of Ethiopia indicated that Ethiopian migrants to the Gulf States are estimated to be 190 thousand. Ministry of Labor and Social affairs, on the other hand estimated it 13.5 thousand only during 1992 – 2001 (see Table 2). The discrepancy may be due to the fact that the latter does not consider those who migrate through illegal channels. In the recent years, it is the young who are moving to the Gulf. A study conducted on women trafficking in Ethiopia confirmed that most women leaving for the Gulf are in the age of 20-30 years.

Table 2: Ethiopian legal migrants in the Gulf States since 1992-2001

Year	Men	Women	Total
1992	1,794	1,688	3,482
1993	2,112	1,020	3,132
1994	251	1	252
1995	397	298	695
1996	803	356	1,159
1997	1,186	728	1,914
1998	757	894	1,651
2000/2001	-	1,163	1,163
Total	**7,300**	**6,148**	**13,448**

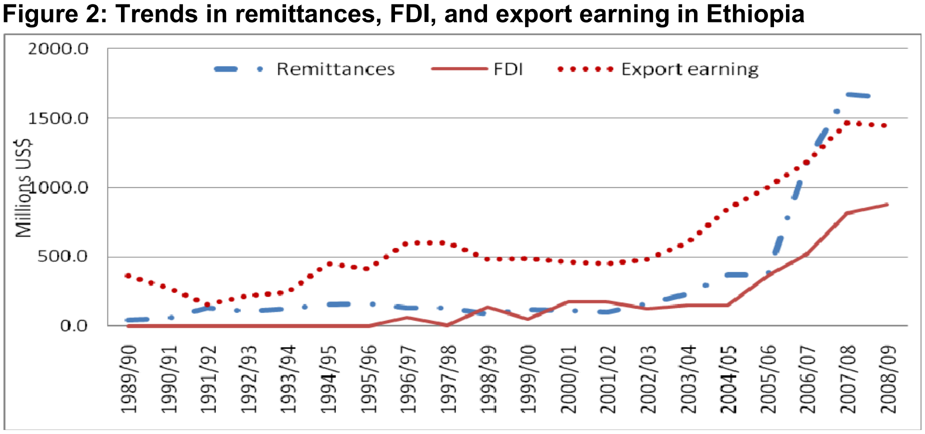
Source: Ministry of Labor and Social Affairs quoted in Adamnesh, 2008.

2.2 Remittance transfers and channels in Ethiopia

Ethiopian migrants are engaged in various occupations in different countries. For instance, in USA, according to the 2000 US Census, 30.6%, 26.6%, 20.5% and 19.3% of Ethiopian migrants are engaged in sales & office, management & professional, service occupation and production & transportation respectively. Similarly, as reported in Agnarson (2006), the share of Ethiopian migrants in Europe in paying works has increased in recent years. On the contrary, most of the male migrants in the Gulf participated as drivers. Of course, some are employed as factory workers, mechanics, laborers, farmers, guards and waiters and in very few cases in such professions as engineers and accountants. Regarding women workers in the Gulf, they are often recruited to work as housemaids except in few cases where they are hired as waitress.

The major channel that Ethiopian migrants could contribute to the country's development and poverty reduction is through remittance. Remittance is becoming a major source of foreign exchange in Ethiopia. According to the National bank of Ethiopia, USD 1.8 billion was received from private individuals in 2008/09 vis-à-vis Foreign Direct Investment (FDI) and export sector (see Fig. 2 and Fig 3.). USD 969 or 54% of this was channeled through the official system, the balance inflow via informal channels. The data shows that official individual international transfers are increasing year-on-year by 33.0 percent on average from US$ 41.3 million in early 1990's. Hence, remittance grew by a higher rate than the economic growth over the same period (which is 4.6 percent).

Figure 2: Trends in remittances, FDI, and export earning in Ethiopia



Source: National Bank of Ethiopia

Remittance is not the only means that Ethiopia could benefit out of its huge number of migrants abroad. Skilled Ethiopians contribute to the country's poverty reduction endeavor by filling the gaps in areas like education and health. In this regard, the International Organization of Migration (IOM) initiated two projects: Return and Reintegration of Qualified African Nationals (RQAN) and Migration for Development in Africa (MIDA). The United Nations Development Program (UNDP) participated in this effort by placing a National United Nations Volunteer Program.

The Ethiopian government established an office, the Ethiopian Expatriate Affairs, under the Ministry of Foreign Affairs in January 2002. The main duties and responsibilities of the office are to provide accurate information to Ethiopian migrants and to conduct research to participate the diaspora in the development of the country. In this regard some positive results have been seen though a huge number of skilled and unskilled labors are still remained abroad.

3. The macro-economic impact of international remittances in Ethiopia

Resource poor developing countries are constrained by lack of foreign exchange to finance the increasing demand for imports associated with domestic investment requirements. For many of these countries, remittances constitute the larger part of foreign exchange earnings; sometimes larger than aid, foreign direct investments and export revenues. The past few decades have witnessed rapid increase in the international flow of remittances all over the world. Remittances have recently become the second largest source of foreign exchange both as a percentage of GDP and in absolute terms globally (see Giuliano and Ruiz-Arranz, 2005). Remittances, therefore, become a relatively attractive source of foreign exchange earnings for developing countries.

Nevertheless, little attention has been paid to analyze the macroeconomic impact of these financial transfers, especially on economic growth. There is also very little effort exerted in some of the developing countries with many migrants to collect as much foreign currency as possible through remittances as their effort through exports. Likewise, despite the gradually increasing level of remittance inflows to Ethiopia, little attention was given to appreciate the impact of remittances on growth and hence poverty reduction. Thus, this particular section will contribute to the literature that links remittances to production and growth.

3.1 A simple accounting framework for remittance flows

This section attempts to identify possible scenarios for the macroeconomic impact of remittance flows in a small open economy like Ethiopia. Hence, the main purpose of our effort is to clearly identify the channels by which remittance inflows can affect macroeconomic aggregates, and hence the macro economy. In the literature (such as by Aggarwal, Demirgüç-Kunt, & Peria (2006), Ratha (2003) and Ratha, D. & Mohapatra, S. (2007)), the macroeconomic impact of remittances is largely through strengthening balance of payments position, building human capital, increasing domestic consumption, and contributing to financial sector development.

One of the most significant impacts of remittances is to increase the foreign exchange earnings of the labor exporting country thereby exerting a positive impact on the balance of payments. Remittances can also help in human capital formation in recipient countries. Studies such as that of Hanson and Woodruff (2003) found the evidence. Likewise, remittances can support the economy by pushing consumption levels with substantial multiplier effects because they are more likely to be spent on domestically produced goods (see for e.g. Ratha (2003)). On the other hand, although, whether and how remittances might affect financial development is a priori unclear according to Aggarwal et al (2006), the view that remittances can lead to financial development in developing countries is dominant. This notion is based on the concept that money transferred through financial institutions paves the way for recipients to demand and gain access to other financial products and services, which they might not have otherwise.

Through those macroeconomic channels and through their direct effects on savings and investment (human and physical capital) and indirect effects through consumption, remittances are hopped to promote economic growth in home countries. To uncover the impacts, we follow the framework of Berg et al. (2006). They provided a full-fledged theoretical model on the macroeconomic impact of aid flows in an economy. However, in this paper, following the work of Hansen and Headey (2009), we rather adopt an accounting approach by using balance-of-payments and the national accounts system as an organizing framework. Unlike Berg et al. (2006), we here follow a simple macroeconomic framework to reveal the impacts of remittance inflow on macro variables (economy wide aggregates) in Ethiopia.

3.1.1 Remittance flow from private individuals in the Ethiopian balance of payments

Transfers in Ethiopia are classified as official and private. Individual/private transfers are best termed as remittance. Hence, we can specify the following balance-of-payments identities for the Ethiopian economy by specifying it in a useful manner for our purpose:

$$CA_t = (X_t - M_t) + W_t - (i_t L_{t-1} + r_t D_{t-1}) + A_t^g \quad (1)$$

$$KA_t = \Delta L_t^o + (A_t^l - A_t^r) \quad (2)$$

The current account at a certain time (CA_t) is defined as the net export of goods and services (export, X , less import, M) plus net private transfers (W), mainly remittances and worker compensation less net interest payments to foreigners ($iL + rD$), with interest payments on market loans (iL) separated from interest payments on concessional aid loans (rD). The final term in the current accounts definition [1] is that of aid grants (A^g). In equation [2], the capital account (KA) is specified simply as the net change in non-aid foreign debt (L^o), which has both private and public elements, plus the foreign aid loan given within the year (A^i), less repayments of principal on the aid loans (amortizations).

Using the fact that the difference between the current account and the capital account equals the change in foreign reserves ($\Delta\ R$), we have the following decomposition of the overall balance-of payments:

$$W = A_t^r - A_t^g - A_t^l + \Delta R_t + (M_t - X_t) + (i_t L_{t-1} + r_t D_{t-1}) - \Delta L_t^0 \quad (3)$$

In the above identity, we have remittance (W) in the left hand side. The identity implies that from a purely accounting perspective, an increase in the private remittance can influence the economy in five various ways. Remittances may: (i) increase foreign reserves; (ii) increase net imports of goods and services; (iii) finance interest payments on foreign debt (both aid and non-aid debt); (iv) finance a decrease in net aid inflows; and (v) decrease net external debt (or increase capital flight).

In countries with foreign exchange shortages such as Ethiopia, there must be some kind of optimal way of 'distributing' the remittance inflow across the balance of payments (BoPs) components shown above, as remittance increases are often observed under a variety of different circumstances (e.g. macroeconomic crises at home). The most common use of remittances is to fund for an increase in net imports. Therefore, we define the rate of absorption of an increase in remittance as the increase in net imports relative to the increase in remittance. Letting Δ denote change over time, absorption of remittance in a given period can be specified as:

$$Absorbtion = \frac{\Delta(M_t - X_t)}{\Delta W_t} \tag{4}$$

Equation [4] reveals that *absorption* can be seen as a measure of the direct, real resource transfer associated with an increase in the remittance inflow. Remittance inflow affects absorption through its impact on demand for private sector imports via aggregate demand.

3.1.2 Remittance flow from private individuals in the Ethiopian national accounts system

Remittances appear directly in the national accounts, specifically as part of disposable gross national income.

$$desp.GNI_t = Y_t + W_t - (i_t L_{t-1} + r_t D_{t-1}) + A_t^g$$

$$= (C_t + I_t + G_t) - (M_t - X_t) + W_t - (i_t L_{t-1} + rtD_{t-1}) + A_t^g \tag{5}$$

The notation given in equation [5] above follows the standard national income accounting representation: Y_t is GDP at time t, C_t is private consumption at time t, I_t is private sector investment (gross capital formation) at time t, G_t is government consumption at time t, and desp.GNI_t is disposable national income. In the second line of the same equation, Y_t is treated as equal to $(C_t + I_t + G_t) - (M_t - X_t)$.

From the above identity, it is evidenced that subtracting net interest payments on foreign debt from GDP and then adding remittance and aid grants yields disposable GNI. Subtracting net interest payments on foreign debt from GDP and then adding remittance also yields GNI. Hence remittance has an impact on both GNI and disposable GNI. As can be seen from equation [5], an increase in private remittance/transfer has no direct impact on the main macroeconomic aggregates constituting GDP. However, in a very foreign exchange and resource scares country like Ethiopia, every additional hard currency can be viewed as 'a blessing from heaven' and will be used to finance net imports from abroad thereby affecting the components of GDP. Such type of characterizing remittance in Ethiopia can help in linking remittances with the macro economy, and hence see the change in total domestic demand (spending) due to change in remittance inflow:

$$Spending = \frac{\Delta(C_t + I_t + G_t)}{\Delta W_t} \quad (6)$$

From the above definition, the private sector may expand its consumption and investment due to private transfers coming into the economy.

3.1.3 Linking absorption and spending to production

Once defining absorption and spending, the other exercise is attempting to see the change in GDP due to change in remittances. This can be represented by the following representation:

$$\begin{aligned} \Pr oduction &= \frac{\Delta Y_t}{\Delta W_t} \\ &= Spending - Absorbtion \quad (7) \end{aligned}$$

Based on this identity, we can discuss different short-run responses as combinations of the spending and absorption of increased inflows of remittances.

In an effort to trace the dynamic impact of remittance flows to highly aggregated macroeconomic variables such as absorption and spending, we will below present a simple macro econometric model for private remittance flows using variables such as export and import.

3.2 A simple econometric model of remittance inflow to Ethiopia

In this sub-section, we are interested in looking at the macroeconomic impact of international remittances to Ethiopia. From the above preliminary discussion, we have learned the need for a dynamic way of modeling the macroeconomic impact of international remittance on a small open economy like Ethiopia. Accordingly, we have formulated and apply a simple dynamic econometric model that seeks to account for the country's net imports, GDP, and domestic demand following a sudden increase in international remittance. This method will help us link/infer the impact of remittance shocks on aggregate variables such as absorption, spending and output. For the purpose of modeling the dynamic relationship, we have chosen and used a vector autoregressive (VAR) model because it does not impose too much a priori structure. Our starting point for the econometric model is the national income accounts identity, measured in constant birr (local currency) units and given as:

$$\begin{aligned} Y_t &= C_t + I_t + G_t - (M_t - X_t) \\ &= D_t - NM_t \end{aligned} \tag{8}$$

In the second line of equation [8], GDP (Y_t) is specified as domestic demand (D_t) less net imports (NM_t), the changes of which are directly linked to our definitions of absorption and spending.

Similarly, the remittance inflow is modeled as W_t. The national income accounts variables in equation (8) and the remittance variable W_t are used to specify a VAR model to investigate the dynamic macroeconomic impact of remittance in the Ethiopian economy. However, because equation (8) is an identity, the covariance matrix of disturbances is singular. As shown in Barten (1969) according to Hansen and Headey (2009), the parameters of the model can be consistently estimated by omitting one of the variables from the system. In the present model, it doesn't matter which variable is omitted. We omit export from the model, meaning that the VAR is specified to include remittances, GDP, domestic demand, and import (a component of spending) [i.e., we consider a 4 x 1 vector $Z_t = \{W_t, Y_t, D_t, M_t\}'$]. The resulting estimable VAR model can be formulated as:

$$Z_t = \sum_{k=1}^{p} \Gamma_k Z_{t-k} + \eta_t \tag{9}$$

where k=1,….,p; and η_t is a zero mean innovation process with $E(\eta_t \eta_t') = \delta^2$ and $E(\eta_t \eta_s') = 0$ for $t \neq s$. All variables are deflated by CPI to take into account of the domestic price volatility.

Most macroeconomic variables tend to be non-stationary at level. If the variables included in *Z* happen to be non-stationary (as most of macroeconomic variables are) and if we suppose that they are stationary by differencing, then we can exploit the idea that there may exist co-movements of these variables and possibility that they will trend to move together towards a long-run equilibrium state (i.e. co-integrated).

Hence, using the Granger representation theorem, we may posit the following testing relationships that constitute a vector error-correction (VEC) model

$$\Delta Z_t = c + \sum_{i=1}^{p-1} \Phi_i \Delta Z_{t-p} + \Pi Z_{t-p} + \mu_t$$

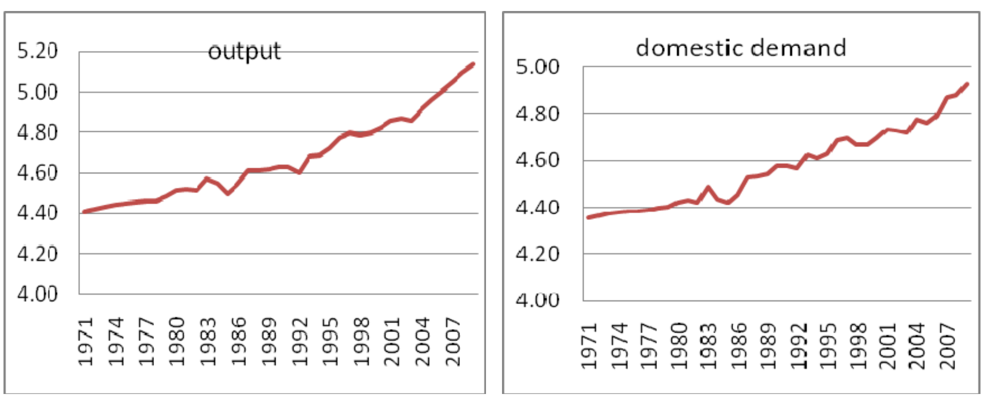
with r co-integrating vectors ($1 \le r \le 4$), Π has a rank r and can be decomposed as $\Pi = \alpha\beta'$ with α and β both are $4X1$ matrices. Johansen's approach uses a maximum likelihood procedure to test the co-integrating rank r and estimate the parameters β and α.

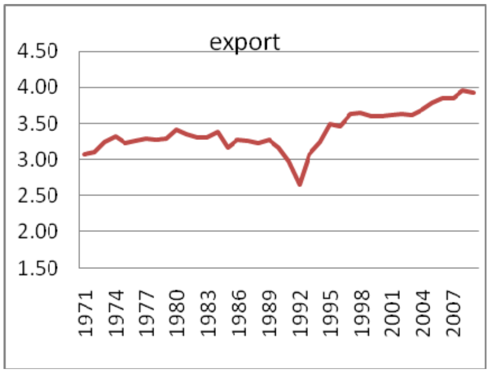
3.3 The data

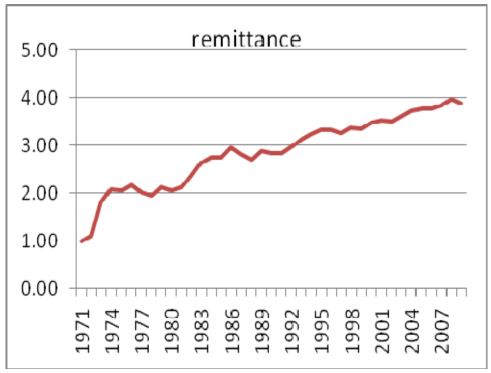
This sub-section describes the definition, source and some characteristics of the data used for the VAR analysis on the impact of remittance inflows on the Ethiopian economy.

The required data for the VAR analysis is extracted from official sources such as the National Bank of Ethiopia (NBE) and Ministry of Finance and Economic Development (MoFED). While the remittance (W), import (M) and export (X) data are collected from NBE, the data on GDP (Y) is extracted from the national accounts of MoFED. Due to data limitation on remittance by private individuals, which is available only after 1989/90, we base our analysis on private transfer data for the sake of having adequate observations (since 1971). Domestic demand is derived from own computation using the identity. We based our analysis on time series data on the above variables. The topology of the variables in log is given in Figure 3.

Figure 3: The topology of selected variables (real and in logs) (1971-2009)







Variables are trending upward very steeply recently. We can also see that domestic absorption follows a closer trend to that of GDP. Export has been a very volatile series since the 1970's. On the other hand, remittances have been persistent in most of the periods despite new volatility in recent years.

3.4 Empirical results

3.4.1 Univariate characteristics

While the graphical presentation of the important variables in the preceding section provides the properties of Ethiopian time series data, it does not provide the complex dynamic pattern of the data. Hence, we have adopted a more rigorous method (VAR modeling) described above.

Before we estimate the system that governs the relationship among our variables, we check for the order of integration of these variables. In analyzing the univariate characteristics of the variables, Augmented Dickey-Fuller (ADF) test was employed to decide the order of integration of the data series. The unit root test shows that our data series are not stationary in level, i.e. they are I (1). See Annex 1, Panel (a). We accordingly should test for the existence of cointegration. If the series are cointegrated, that means there is long run relationship between them.

In testing for the existence of cointegration, we have undertaken Akaike information criterion (AIC) and Schwartz criterion (SIC) for choosing the optimal lag length. The selection criterion decided (1 1) as the optimal lag length and the unrestricted VAR model is estimated using this optimal lag. See Panel (b) of the same annex.

The existence of cointegration is tested using the methodology developed by Johansen. Testing for trend stationarity, some of the included variables were found to be trend stationary. Hence, in checking for cointegration, we have assumed intercept and trend in the cointegraion equation. The test reveals the existence of one cointegrating vector. The cointegration test result is indicated in Panel (c) of Annex 1.

Given our assumptions, we have found cointegrating relationship. We have verified the existence of cointegration among our non-stationary series and can proceed to the VEC specification. An important application of interest to accomplish using the VEC approach is conducting the short-run impulse response analysis and variance decomposition to innovations. In the following part we have analyzed the adjustment of important macroeconomic variables to remittance shocks using impulse response representation. The long-term relationship among the variables based on the unrestricted VAR is provided in Annex 2. The variables were estimated in logs.

3.4.2 Impulse response function

An impulse response function traces out the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. A shock to the i^{th} variable directly affects the i^{th} variable, and is also transmitted to all of the endogenous variables through the dynamic structure of the VEC.

Table 3 provides the response of all variables to a one standard deviation shock of remittance inflows. It shows how variables included in the model are responding to a one standard deviation (increment) in remittance flows at a certain point, given the dynamic relationship modeled. The impulse response function based on the VEC analysis reveals that remittance responds highly during the first year after its own shock. Specifically, the impact persists for the first year before it shows a quick decline during the succeeding two years. After reviving in the fifth period, it maintains its rate. The shock remained to have a positive impact all over the period considered. This implies that Ethiopia cannot assume a certain increment in remittance flow as smooth and permanent shock as it is fluctuating after the shock. On the other hand, domestic demand is not quickly reacting to a certain standard deviation in the remittance variable. However, through time, domestic demand reacted positively (but volatile) to the innovation in the remittance variable to reach its maximum in the third period. Also see Annex 3.

Table 3: Effects of Cholesky (d.f. adjusted) one S.D. remittance innovation (real variables)

Period	Log remittance	Log domestic demand	Log GDP	Log import
1	0.243507	0.007351	0.013000	0.059218
2	0.266721	0.019420	0.028068	0.088395
3	0.243077	0.020769	0.031854	0.100770
4	0.235449	0.018473	0.029357	0.094428
5	0.241757	0.017320	0.027661	0.090016
6	0.246297	0.017621	0.027829	0.090218
7	0.246159	0.018035	0.028362	0.091568
8	0.244881	0.018088	0.028490	0.091941
9	0.244515	0.017991	0.028384	0.091693
10	0.244751	0.017944	0.028315	0.091508

The impulse response of imports (the component of spending) to a one standard-deviation innovation to remittance shocks mirrors the response of domestic demand. Imports expand in the second period after the shock and reached its maximum in the third period. The rate consistently declines up to the fifth period. The impact of a one standard-error shock maintains its level all through the period considered. Given the level of export, this implies that a surge in remittance flows increases the importing capacity (spending) of the foreign exchange scarce economy of Ethiopia. Like domestic demand and imports, GDP is volatile as a result of remittance shock in the first four years; taking an increasing rate up to the third year and then declining up to the fifth period. The response of output for any remittance innovation is owing to the impact on domestic demand and spending as a result of shocks in private remittance.

3.4.3 Variance decomposition results

Variance decomposition is another method of depicting the system dynamics. In contrast to impulse response function which depicts the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. It gives information about the relative importance of the random innovation to the variable in the VAR. More specifically, variance decomposition shows the proportion of shocks in the remittance innovation attributed to all endogenous variables included in the model.

The variance decomposition shows that a one-time shock in the remittance variable explains the larger part of movement in remittances. Remittance shocks explain about 88.6 percent of the variance in itself in just a year after the innovation (see

Table 4). The contribution on remittance of own shock declined only to 67 percent in five years time implying remittance shock persists somehow during the period considered. On the other hand, remittance shocks explain close to 6.8 percent of the variation in the domestic demand in the tenth year from less than 0.1 percent just after the remittance shock. Surprisingly, the variance decomposition exposes that remittance shocks explain only 4.7 percent of the variation in imports (hence spending) over one-year horizon before it rise to around 22.8 percent at the end of the tenth year. The variance decomposition of a remittance shock to domestic demand and imports reveals an interesting observation. Remittance shocks affect imports more than domestic absorption implying the role of additional foreign exchange earned through remittances in increasing spending. Variation in output as a share of total variation as a result of remittance innovation increases from 6.6 percent in the second period to 8.6 percent in the third period.

Table 4: Variance decomposition (in %) of remittance shocks (variables are real)

Period	S.E.	Log remittance	Log domestic demand	Log GDP	Log import
1	0.243507	100.0000	0.000000	0.000000	0.000000
2	0.383690	88.60063	0.122999	6.660249	4.616120
3	0.495150	77.30137	1.303668	8.572304	12.82266
4	0.591597	69.99067	3.635418	8.358807	18.01510
5	0.673323	66.92302	5.097915	7.943828	20.03524
6	0.745003	65.59417	5.742464	7.769215	20.89415
7	0.810324	64.67329	6.082282	7.725747	21.51868
8	0.871031	63.87657	6.355942	7.698621	22.06887
9	0.927871	63.23473	6.594130	7.662477	22.50867
10	0.981388	62.74583	6.784964	7.628591	22.84062

4. Livelihood consequences of migration on the welfare of households

As discussed in the preceding sections, migration has emerged as an important policy issue in developing countries, with supporters advocating the many opportunities it offers to the development of both the migrant sending and receiving economies. The transmission channels through which migration and remittances can have an impact on various living standards and human capital outcomes are numerous. The most obvious is the income channel, namely that remittances directly contribute to total income of a household.

Remittances lead to increased consumption and investment, implying a positive effect on poverty reduction and human capital (Sasin and McKenzie, 2007). Previous empirical findings show that international remittances have an important source of improvement in the welfare of households in Nepal (e.g. Subedi, 2009) and in Ghana (e.g. Quartey, 2006). Subedi (2009) showed that remittance income is an important source of household income in Nepal. It accounts for about 11 percent of all households' income and more than two-thirds of the remittance recipient households' income. Moreover, Quartey (2006) found that migrant remittances improve household welfare and the flow of such remittances increase in times of economic shocks in Ghana, hence they are counter-cyclical. Thus remittances help to minimize economic shocks that reduce household welfare, particularly for food crop farmers. A study by Gupta et al. (2007) confirm that a 10 percent rise in the remittances-to-GDP ratio is associated with a fall of a little more than 1 percent in the percentage of people living on less than USD 1 a day.

Remittances directly augment the income of recipient households by providing financial resources for poor households. They affect poverty and welfare through indirect multiplier effects. Remittances are associated with increased household investments in education, entrepreneurship and health—all of which have a high social return in most circumstances. The objective of this section is to see if remittances from Ethiopian migrants abroad can improve the welfare status of Ethiopian households. Poverty profile and binary outcome models are used.

4.1 Methods

Whether remittances improve the welfare of households can be achieved by constructing a poverty profile using consumption as a welfare indicator (see for e.g. Couduel et al., 2002; Ravallion, 1994; Tassew et al., 2008; Bigsten et al., 2005). This way of analysis allows us to make poverty comparison and provides us with information on the welfare status of households having international remittances and those not having these remittances.

The choice of consumption as a welfare indicator is that it gives a better indicator of living standards. Consumption is believed to vary more smoothly than income both within a given year and across the life cycle (Douclos and Araar, 2006; Couduel et al., 2002). Moreover, income is more erratic than consumption. Consumption is not equal to consumption expenditures because the value of consumption equals the sum of expenditures on goods and services purchased and consumed in a given period plus the value of goods and services consumed but not purchased such as gifts and those produced by the household itself plus the consumption of durable goods and services owned (Thorbecke, 2005; Douclos and Araar, 2006).

The poverty line estimated by the government of Ethiopia was taken as given in this study. This estimate was based on the cost of 2,200 kcal per day per adult food consumption with an allowance for essential non-food items. The levels of real total per adult household consumption expenditure was estimated ETB 1075.0 per annum per adult equivalent at 1995/96 national average constant prices.

A group of poverty indices called the Foster-Greer-Thorbecke (FGT) class are used to construct poverty profile. Given the variable of interest $\mathbf{y_i}$ (i.e. consumption) ordered in an ascending order where z is an exogenously given poverty line below which an individual is classified as poor, we can have the following ratio,

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - y_i}{z}\right]^\alpha \qquad \textbf{(10)}$$

where q is the number of poor people below the poverty line, n is the total number of people in the population, z is the poverty line and y is consumption level. Alpha (α) is an ethical parameter which is considered to be greater than or equal to zero. For $\alpha = 0$, it is the head count ratio, for $\alpha = 1$, it is the poverty gap and for $\alpha = 2$, it is the squared poverty gap.

Another important analytical tool to see the impact of remittances on welfare binary outcome model. Given the following functional relation,

$$\mathbf{Y_i = F(rem_i, X_i, \varepsilon_i)} \qquad \textbf{(11)}$$

where y_i represents consumption, rem_i is a remittance, χ_i other explanatory variables and ε_i is the error term, an increasingly common approach is to construct a regression model of welfare measure against a variety of household and community characteristics (see for e.g. Ravallion, 1996; Couduel et al., 2002; Bigsten et al., 2002; Bigsten et al., 2005). The general binary outcome models can be written as the conditional probability to be poor, i.e. $p(w_i = 1/x_i)$, as

$$p(w_i = 1/rem, x_i) = E(w_i/rem, x_i) = F(rem, \chi_i, \beta).$$

If we define the logistic function $\Lambda(z) = \dfrac{\exp(z)}{1+\exp(z)}$, we can get the following logit model,

$$F\left(rem_i, \chi_i, \beta\right) = \Lambda\left((rem_i, \chi_i)' \beta\right). \qquad \textbf{(12)}$$

A maximum likelihood estimation (MLE) is applied to estimate the model.

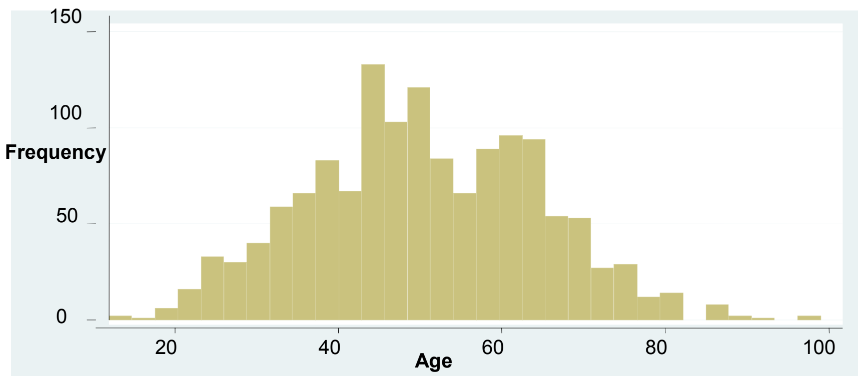
The data used in this study came from a household survey undertaken by the department of economics of Addis Ababa University. The sample size stands at 1500 urban households in seven major towns. The survey collected include data on the demographic characteristics of households, their educational and health status, ownership of assets, employment and income, credit availability, consumption, remittance, expenditure and a host of other household variables.

4.2 Discussion of results

4.2.1 Descriptive analysis

Some of the variables included in the study are described in this sub-section. The age distribution of the households covered in the study has a normal distribution. Approximately 85 percent of the respondents are within the age range of 15-65. The age distribution of 1490 respondents is presented in the following histogram. The most frequently appearing age group is 45 to 47 with a frequency of 140 respondents. Since the issue of remittance involves different age ranges, it is important to have respondents with a normally distributed age profile.

Figure 4: Age distribution of respondents



Source: Authors' calculations from AAU Urban Household Survey (2004)

Regarding the educational status of respondents, close to 55 percent of the respondents are literate which means they can at least read and write while 27 percent are illiterate.

Table 5: Educational attainment of respondents

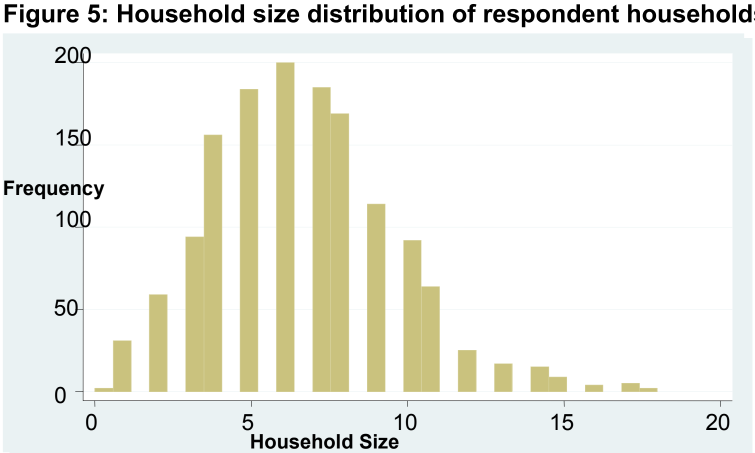
Education Accomplishment	Freq.	Percent
Illiterate	404	27.11
Literate	91	6.11
Primary	338	22.68
Secondary	252	16.91
Tertiary	19	1.28
Technical and Vocational	118	7.92
Total	1,490	100.00

Source: Authors' calculations from AAU Urban Household Survey (2004)

Again, a representative sample has been taken with regard to educational background to see the importance of remittance in the different education levels. As expected, the frequency at each level decreases as we go up the education ladder.

Another important variable of concern is the household size. Depending on the rate of dependency in the specific household, it is generally believed that as household size increases the incidence of poverty increases as the per capita consumption is expected to decline in an average household. In the data at hand, most frequently appearing household size is 5 to 6, which is nationally representative as the average household size in Ethiopia, is 4 according to the 2007 census results in the urban areas.

Figure 5: Household size distribution of respondent households



Source: Authors' calculations from AAU Urban Household Survey (2004)

Turning now to whether or not the respondents are working or not, 55 percent of the respondents are working while 40 percent are not working. This characteristic is slightly higher than the national urban unemployment rate of 26 percent in the 2004/05 labor force survey. As regards gender of respondents, approximately 52 percent of them are male respondents while 42 percent are female respondents. Around 6 percent didn't give information. This is another variable that reflects the real gender distribution in Ethiopia.

Table 6: Gender distribution of respondents

	Freq.	Percent	Cum.
Female	624	41.88	41.88
Male	782	52.48	94.36
Missing	84	5.64	100
Total	1,490	100	

Source: Authors' calculations from AAU Urban Household Survey (2004)

Apart from individually looking at the household characteristics it is also important to look at the correlation among them. The table below presents the correlation matrix of the major variables used in the analysis.

Table 7: Correlation matrix of poverty related variables

	Poverty	Age	Education	working	HH Size	Remittance
Poverty	1.0000					
Age	0.0884	1.0000				
Education	-0.248	-0.3734	1.0000			
Working	-0.0234	-0.3542	0.2424	1.0000		
Household Size	0.1816	0.1635	-0.0012	0.0172	1.0000	
Remittance	-0.1033	0.0968	-0.0124	-0.1029	0.0591	1.0000

Source: Authors' calculations from AAU Urban Household Survey (2004)

Poverty seems to relate better with education and household size negatively and positively respectively, as expected. The subject of this study, remittance, has a negative correlation with poverty as expected but with a weak coefficient.

4.2.1 Regression results

One way of observing the effects of remittances on poverty is to compare the incidence of poverty of those who get these remittances and those who do not. We need to construct a poverty index on each group. To construct poverty profile using our data, we make use of the Foster-Greer-Thorbeke (FGT) measure of the incidence, depth and severity of poverty. The FGT index is calculated on 1373 household observations after making adjustments. Out of these, only 162 get remittances from abroad and the rest do not. The analysis is done by calculating the FGT index on those who get remittances and those who do not. The following table summarizes the results obtained from the calculations. The head count index of the total sample is 0.37 (i.e. 37 percent of the sample households are below poverty line. This figure is a little bit greater than the estimate made by MoFED, i.e. 0.35 percent, for urban households with samples greater than that used for this study; however, there is no a statistical difference.

Table 8: Head count, poverty gap and squared poverty gap of poverty of the sample households

FGT*	Total Sample	Remittances Recipients	Remittances Non-recipients
P0	0.37	0.22	0.39
P1	0.13	0.07	0.14
P2	0.06	0.03	0.07

Source: Authors' calculations from AAU Urban Household Survey (2004)
*P_1 =headcount index, P_2 =Poverty gap index and P_3 =Squared poverty gap.
Note: Poverty line=Birr1075 (estimated by MoFED).

Coming to the headcount index for those households who do receive remittances, only 22 percent of them are below poverty line, much below the index for the total sample. On the other hand, the index for households who do not receive remittances (i.e. 39 percent) is the highest of the three groups of households. This index is much higher than the index for households who receive remittances (22 percent) showing the big difference in the incidence of poverty between the two groups. We can say that the proportion of people in poverty is close to half for those who get remittances from abroad compared to those who do not get these remittances. This difference was found to be statistically significantly different. This result tells us that these remittances do really contribute in reducing poverty and improve the welfare of households in the sample.

The above analysis is a univariate one and does not hold the ceteris paribus assumption. We try to focus on the effects of remittances on the probability of being poor in a typical urban household in Ethiopia. We hypothesize that the probability of being poor is inversely related with the fact that the household receives remittances. Other covariates included in our model are the age of the head of the household, household size, education accomplishments of the head of the household such as reading and writing (literacy), completion of primary school, completion of secondary school, graduating in technical and vocational and university graduate. The gender of the head of the household and the interaction term between gender and remittance were used to capture the gender disparity on effective utilization of remittance to reduce poverty. Dummy for employment (whether the household members are working or unemployed) are also included in the model. Since we are interested in the effect of international remittances on household poverty, we treated the effect of international and domestic remittance separately.

Based on the household survey, we estimated the logistic equation and obtained the marginal effects. The regression statistics show that the model generally fits the data well. We reject the null hypothesis that all variables jointly have no significant impact on poverty probabilities using Wald Test at alpha =0.01%. The specification test shows there is not significant information to reject the model entailing the model is correctly specified. The marginal effects of regression result show that all the predictors have the correct signs and almost all are significantly different from zero at conventional levels of significance.

As can be seen in Annex 4, the marginal effect of remittance is negative and significant at 1% level. It indicates that international remittance has a significant effect on the probability of a household's being non-poor suggesting that the probability of a household being poor decreases by 25 percent when a household receives remittances. Furthermore, it was also noticed that the marginal effect of receiving an international remittance is relatively large next to higher education attainments (secondary and technical & vocational and university) on poverty incidence in Ethiopian urban households.

The marginal effect of remittances from domestic sources, on the other hand, shows it has no significant impact on the probability of a household being poor. This is presumably due to the fact that a significant proportion of the urban dwellers are themselves poor and hence they send a small amount of remittances to other urban areas. The marginal effects of gender are negative but statistically insignificant suggesting that differences in gender do not have any effect on the poverty status of households in the sample. To see whether the association between poverty and remittance is gender dependent, we used the gender and remittance interaction term (i.e. remittance & gender). The marginal effect of remittance & gender is significant at 5% suggesting the gender of recipient of the international remittance has significant impact of poverty incidence among Ethiopian urban households, all other things being equal. The sign of this variable tells that if the receiver is male headed the probability of being poor increases by 0.265 compared to that of female-headed households.

The marginal effect of education shows that if the head of the household attend primary, secondary, vocational and university schools, the probability of being poor dropped significantly at common levels of significance. The marginal effect of literacy, on the other hand, has the expected sign but is only significant slightly at 10%. Overall, the probability of a household being poor decreased with education at all levels. The marginal effect of age of the household has the expected sign but not significant. The marginal effect of workers, household size is positive and significant at 1 percent. These effects suggest that the probability that the household falls into poverty increases with the size of the household and the number of workers in the household.

5. Conclusions and policy implication

Migration with its concomitant remittance has diverse socio-economic impacts: increasing better opportunities for the migrant, improving the livelihood of sending households and contributing economic growth and has emerged as an important policy issue in developing countries. Ethiopia, being one of the highest African diaspora populations, is challenged by different migration patterns and dynamics, which have significant political and socio-economic ramifications for the country and undoubtedly affects the government's sustainable development and poverty reduction programs. Ethiopia, as in any other resource poor developing countries, is constrained by foreign exchange availability to finance the increasing demand for imports associated with domestic investment requirements. Remittances constitute the larger part of foreign exchange earnings sometimes larger than foreign direct investments and export revenues. Another transmission channel is through increasing income where an inflow of remittances impacts various living standards and human capital outcomes.

The objective of this study was to see the macroeconomic impact of inflows of international migrant remittances and the livelihood consequences of these remittances on the welfare of households and on poverty reduction. A simple vector error correction model was adopted to describe the macroeconomic impact of remittance shock on the Ethiopian economy. Furthermore, a poverty profile and binary outcome model were used to see the consequences of remittances on the welfare of households.

The result, using vector error correction model provides us some surprising results. It helped us know that while remittance shocks positively affect macroeconomic variables, the effect remained to be volatile in the very first periods after the shock. However, the impacts tend to sustain in the years after the fifth period. We also analytically saw that through the positive (but inelastic) relationship between growth and poverty, private remittance inflows have an important implication on poverty in Ethiopia.

The microeconomic approach has also revealed similar evidence. It was found that, using poverty profile and binary outcome models, international remittances significantly reduced the poverty incidence among the urban households in Ethiopia. We found that women are more likely to use remittance more effectively than their male counterparts. Thus the policy implication of these findings is that policy makers in Ethiopia should encourage diaspora citizens to increase remittance inflow via different incentive packages. The gender difference on the effectiveness of international remittance also implies Ethiopians in the diaspora sending remittance to their households should channel more of the remittance via female members of their households if their objective is to reduce poverty in their households. Further, the banking system in Ethiopia needs to minimize the transaction costs to channel the remittance via the legal channel to reduce urban poverty.

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Annexes

Annex 1: Univariate Characteristics of Variables and Cointegration Test

Panel (a): Unit root test (1971-2009)

Series	Level	1st Difference	Critical Value		Order
			1 %	5%	
LRW	-1.3056	-6.9118	-3.6210	-2.9434	I(1)
LRY	1.9631	-5.0211	-3.6210	-2.9434	I(1)
LRD	1.3105	-5.8646	-3.6210	-2.9434	I(1)
LRX	-0.9855	-4.1518	-3.6210	-2.9434	I(1)
LRM	0.7108	-4.4767	-3.6210	-2.9434	I(1)

*The ADF tests were carried out with intercept; variables are real and in their logs.

Panel (b): Choice of optimal lag

Lag length	Akaike	Schwartz
(1 1)	-7.71	-6.85
(1 2)	-7.69	-6.12
(1 3)	-7.33	-5.04

Panel (c): Unrestricted Cointegration Rank Test (Trace)

Sample (adjusted): 1973 2009

Included observations: 37 after adjustments

Series: LRW LRD LRY LRM

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.544223	66.96163	63.87610	0.0269
At most 1	0.486670	37.88885	42.91525	0.1454
At most 2	0.225047	13.21593	25.87211	0.7212
At most 3	0.097182	3.782656	12.51798	0.7733

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Annex 2: Vector Auto regression Estimates (Long-run relationship)

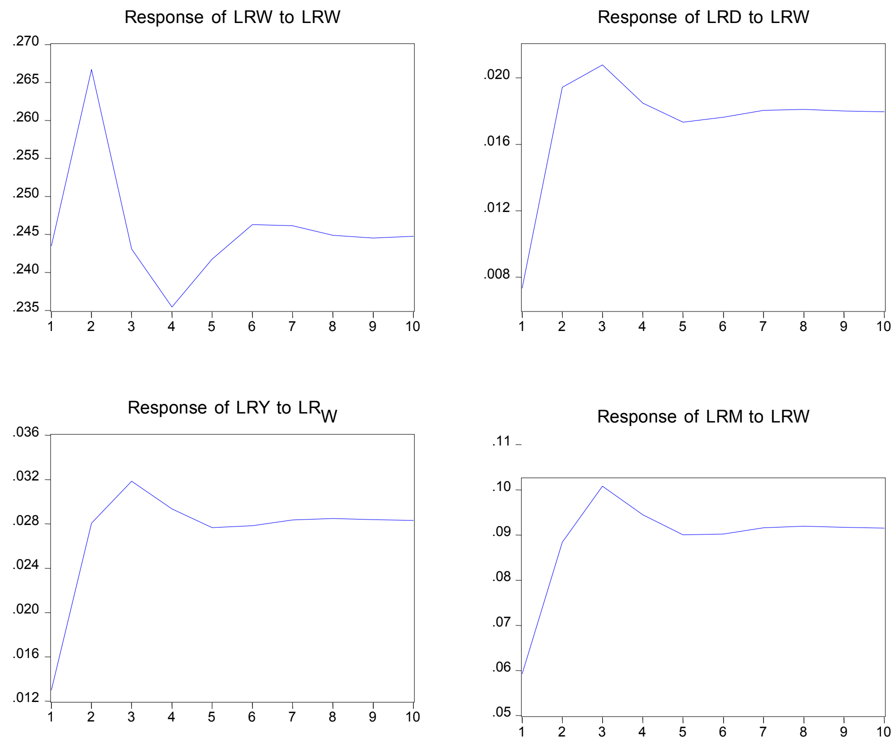
Vector Auto regression Estimates
Sample (adjusted): 1972 2009
Included observations: 38 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LRW	LRD	LRY	LRM
LRW(-1)	0.500138	0.014596	0.009763	0.025894
	(0.05576)	(0.01291)	(0.01260)	(0.03943)
	[8.96897]	[1.13073]	[0.77470]	[0.65668]
LRD(-1)	4.865985	0.484273	-0.307719	-0.883188
	(1.55814)	(0.36070)	(0.35213)	(1.10181)
	[3.12294]	[1.34258]	[-0.87387]	[-0.80158]
LRY(-1)	-4.093437	0.492160	1.393743	1.674266
	(1.83683)	(0.42522)	(0.41511)	(1.29887)
	[-2.22853]	[1.15743]	[3.35750]	[1.28901]
LRM(-1)	0.869810	-0.054676	-0.071927	0.489450
	(0.39363)	(0.09112)	(0.08896)	(0.27835)
	[2.20972]	[-0.60002]	[-0.80855]	[1.75842]
C	-11.27437	0.551268	-0.387843	-4.346732
	(3.29613)	(0.76304)	(0.74491)	(2.33078)
	[-3.42049]	[0.72246]	[-0.52066]	[-1.86492]
R-squared	0.974022	0.974097	0.984213	0.960790
Adj. R-squared	0.970873	0.970958	0.982300	0.956037
Sum sq. resids	2.521710	0.135138	0.128792	1.260928
S.E. equation	0.276433	0.063993	0.062472	0.195474
F-statistic	309.3286	310.2496	514.3423	202.1547
Log likelihood	-2.379331	53.22213	54.13602	10.78936
Akaike AIC	0.388386	-2.538007	-2.586106	-0.304703
Schwarz SC	0.603858	-2.322535	-2.370635	-0.089231
Mean dependent	6.678315	10.54086	10.77488	8.745371
S.D. dependent	1.619740	0.375505	0.469568	0.932277

Determinant resid covariance (dof adj.)	3.23E-09
Determinant resid covariance	1.84E-09
Log likelihood	166.4996
Akaike information criterion	-7.710503
Schwarz criterion	-6.848616

Annex 3: Impulse Response Function

Response to Cholesky One S.D. Innovations



Annex 4: The marginal effects logistic regression

y = Pr (pov) (predict)

= .34138792

Variable	dy/dx	Std. Err	Z	P>|z|	[95 %	CI]	X
Remittances*	-0.255	0.048	-5.320	0.000	-0.349	-0.161	0.120
Age- HH head	-0.007	0.007	-0.960	0.337	-0.021	0.007	51.421
(Age-HH head)^2	0.000	0.000	0.800	0.426	0.000	0.000	2827.470
HH size	0.079	0.021	3.670	0.000	0.037	0.121	6.728
(HH size)^2	-0.003	0.001	-2.170	0.030	-0.006	0.000	53.941
Literacy*	-0.081	0.050	-1.610	0.107	-0.180	0.018	0.074
Primary Educ*	-0.155	0.033	-4.640	0.000	-0.221	-0.090	0.273
Secon Educ*	-0.291	0.030	-9.590	0.000	-0.351	-0.232	0.205
Tech-Voc*	-0.292	0.048	-6.060	0.000	-0.386	-0.197	0.016
University*	-0.356	0.023	15.410	0.000	-0.402	-0.311	0.099
Male*	-0.026	0.036	-0.730	0.465	-0.096	0.044	0.575
Working*	0.025	0.034	0.730	0.468	-0.042	0.091	0.576
Rem-Gender*	0.265	0.119	2.230	0.026	0.032	0.499	0.067
Remittance(Dom)	0.000	0.000	-0.570	0.567	0.000	0.000	140.152

Source: Authors' estimation based on AAU Urban Household Surveys (2004)

(*) dy/dx is for discrete change of dummy variable from 0 to 1

THE IMPACT OF REMITTANCES ON THE ETHIOPIAN ECONOMY: A CGE ANALYSIS

Tewodros Mekonnen[1], Kassahun Aberra[2], Getachew Ahmed[3] and Emerta Asaminew[4]

1. Introduction

With the progress of globalization and advancement in transportation migration patterns have increased significantly. According to the United Nations estimates (UN, 2006), between 1960 and 2005 the number of international migrants in the world more than doubled, passing from an estimated 75 million in 1960 to almost 191 million in 2005, an increase of 121 million over 45 years. Migration Brings with it different benefits including financial in the form of remittances. According to the World Bank (World Bank, 2006), remittances have reduced the share of poor people in the population by 11 percent in Uganda, 6 percent in Bangladesh and 5 percent in Ghana. Remittance income is also associated with higher school attendance in the Philippines, improved health outcomes in Guatemala and increased investment in microenterprises in Mexico.

Ethiopia is challenged by different migration patterns and dynamics, which have significant political and socio-economic ramifications for the country. This country has one of the highest African diaspora populations, which undoubtedly affects the government's sustainable development and poverty reduction programs. According to Dejene (2005) international migration is increasing starting from the late 1970's, which is the result of the political instability at that time. Nowadays, so many Ethiopians, skilled and unskilled, cross border to different countries legally and illegally looking for better economic opportunities. The main destinations for Ethiopians are North America, Europe, and the Middle East (Dejene, 2005). While the migration of women originating from relatively poor to rich countries in the Middle East and their employment as domestic worker is widely known, very few people know about the large numbers of Ethiopian women working in Arab countries. As a

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result the role of remittances they send back home to poverty reduction has been underestimated. In the past ten years Lebanon, Saudi Arabia and the Gulf States have become common destinations for Ethiopian women in search of a better future. The remittances sent back to their home countries constitutes a large amount of foreign exchange used for poverty alleviation at the household level (when their families receive the remittances). It also adds to the stock of international foreign exchange reserve of the country.

Given that remittances contribute to the foreign exchange earning of the country more than exports it is important to think of ways to increase it. If we give the necessary incentives it is likely that remittances could increase significantly further supporting the scarcely needed foreign exchange. Apart from its contribution to foreign exchange, it is important to see the micro level benefits of remittances in terms of household investment and consumption.

This paper is set out to simulate the increase of remittances on the level of household income and expenditure using a CGE analysis.

2. Migration patterns and remittances

2.1 Global situations

People leave their place of origin permanently or temporary to take advantage of opportunities in the host countries. These opportunities could be economic, social, political environmental or a combination of all these factors. The tempting wage gaps between developed and developing countries, inviting immigration programs in the developed world, lack of democracy and good governance in the home countries, poverty and environmental degradation in the home countries are some of the pushing and pulling factor for international migration (Portes,1996).

Migration has mixed effect on the home and host countries. For instance, United States of America is the leading beneficiary of migration as it is populated by the immigrants and their descendants. In this country, many young people go to college or universities as they are not interested in manual work. Thus, the gap is filled by migration of young people from developing countries. Skilled and educated people also migrate to live and work to developed countries contributing to the growth of the countries they migrate too.

According to the 2005 World Migration Report of the IOM, Australia, North America, Europe, Africa and Latin America host 18.7%, 12.9%, 7.7%, 2%, 1.4% and 1.1% of the world migrant stocks at the end of 2005, respectively. The three top migrant receiving countries are United States, Russia and Germany accepting 35 million, 13.3 million and 7.3 million migrants respectively at the end of 2005. On the other hand, China, India and the Philippines are the three most migrant sending countries sending 35, 20 and 7 million people at the end of 2005. In 2002 Annual Migration Report of the IOM, while Mexico, India, the Philippines and Egypt received USD 11 billion, 8.4 billion, 7.4 billion and 2.8 billion respectively from remittance receipts, USA, Saudi Arabia, and Germany remit USD 28 billion, 15 billion and 8 billion respectively.

In addition to being source of foreign exchange, migration might also have potential benefit to home countries as it may: (i) ease population pressure in developing countries, and (ii) reduce unemployment problem of developing countries. This argument, however, is very controversial as most of the emigrants from developing countries are qualified and potential entrepreneurs. In this case, migration may exacerbate the unemployment problem of the host country instead of lessening it. Furthermore, since most of the migrants are economically active, it may jeopardize the long term development effort of poor countries by drawing out the economically active segment of the society (Siliji, 2001).

Global legislations regarding migration

The fact that Migration concerns different states and countries makes it a more complicated subject with respect to instilling and enforcing certain principles. Setting up different laws concerning migration requires the tandem efforts of different countries recognizing the common importance of treating migrants properly. Migrants and their families are sometimes subject to different types of unfair treatments in the host countries. This may be in terms of discrimination in work places, intolerance of their culture and poor living conditions. To address this situation different efforts have been made worldwide.

Although there are some common principles different types of migrants face different difficulties and should be seen distinctly. There are labor migrants, refugees and asylum seekers. The nature of migration for the three groups is different. Labor migrants go to the host country looking for employment while refugees migrate because of fear of persecution in their country of nationality.

In July 1951, a convention relating to the status of refugees was signed in the United Nations. Underlined in this convention are principles in the treatment of refugees and stateless persons. Provisions are included that bind both refugees and the country they find themselves in. Article 2 of this convention states that refugees should abide by the laws of the country in which they seek refugee. Articles 3 to 11 state general

provisions and provisions specific to certain category of refugees. Some of the general ones include non-discrimination based on race, religion, political opinion; the right to practice religion; the provision of human rights and other provisions.
In July 2003 the International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families came into force. It was ratified by 33 countries by 2005. The main focus of the convention is to raise issues that relate human rights with migration. This convention is a result of years of discussion that began in 1972. It has a number of provisions including, non discrimination with respect to rights, human rights to all migrants (both regular and irregular migrants), the promotion of sound, equitable and humane conditions in connection with international migration, and others.

Some countries devise specific policies for migrants to effectively use the advantages of migration and minimize the disadvantages. One of such policies is the “Temporary Migration” policy adopted in some countries. A paper by Mohammed Amin (2007) talks about ensuring temporariness of migration by enhancing the cooperation of the origin and the host countries. In most developing countries migration seems to be skewed towards the skilled labor force hurting the human capital base of these countries. On the other side developed countries don’t want above a certain level of unskilled people in their countries. Temporariness of migration could alleviate the impacts of both of the conditions above since the developing countries won’t lose their productive human capital if the migration is temporary. At the same time developed countries wouldn’t mind having more unskilled migrants if it is temporary. However, temporariness could only be achieved if there is cooperation between the country of origin of the migrants and the host country.

2.2. Migration and remittances in Ethiopia

According to the UN (2008) Revised Population Database, 546,000 Ethiopian migrants live in different parts of the world. This estimates is, however, very small vis-à-vis the Ministry of Foreign Affairs estimates which sometimes reach as big as 1.5 million. According to 2007 population and Housing Census, Ethiopian Population grew by about 2 million people every year. This entails that more than 120 thousand Ethiopian left their country every year. By the same token, Ethiopia is one of the poorest countries in the world with poverty head count index of 29.2 in 2009/10. Thus remittance would have significant impact on the livelihood of poor in Ethiopia
.
Political and economic reasons accounted for the increase of Ethiopian migrants since 1970s. The 1974 revolution that over through the Emperor Haile Sillasie and installed a Marxist junta that purged or killed a large number of Ethiopians most of

them young was the major causes of migration in Ethiopia. But it does not mean that economic and political reasons are the only reasons. According to Abye (2003), some migrants come from a well to do family who can afford the travel and living expenses abroad. Thus, who are facing the hardship at home are not those who migrate because poor don't afford to travel. Hence, it can be argued that although the initial reason of migrants is political instability, the recent migration trend can be accounted for the desire to acquire Western culture and enjoy better standard of living. This, however, does not include those who migrate to the Middle East where their case is purely economic.

People migrate from Ethiopia mainly through family ties, networks, labor brokers, smugglers and traffickers. Businesses meeting and conferences are also becoming major source of migration these days. Young women are the main victims of traffickers in Ethiopia. According to Emebet (2006), 14,000 Ethiopian women were domestic workers in Beirut and 17,000 in Lebanon. But the official data shows only 6,148 women left the country legally during 1992-2001. This shows that a significant number of Ethiopian women go through illegal channels. Some women also move to Saudi Arabia and other Arab states through Oumra and Hajji. On the other hand, the major channel that people migrates to USA is via DV lottery.

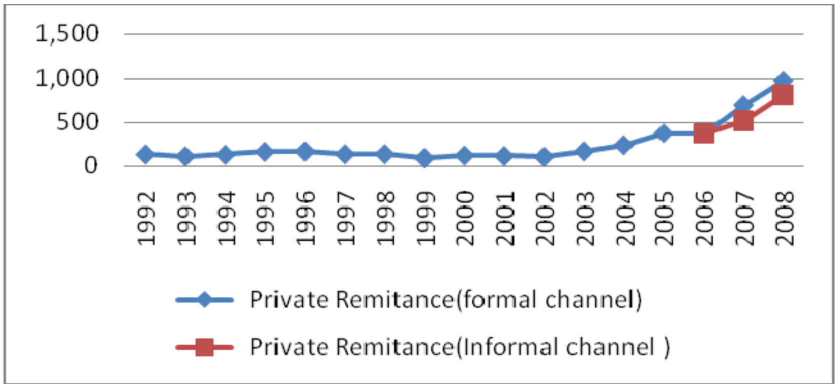
The major channel that Ethiopian migrants could contribute to the country's development and poverty reduction is through remittance. Remittance is the major source of foreign exchange in Ethiopia. According to 2007/08 Annual Report of the National bank of Ethiopia, USD 1.8 billion was received from private individuals living in the rest of the world in 2008 (see Figure 2.2). Of which USD 969 million or 54% was channeled through the official system, the balance inflow via informal channels. Assuming 1.5 million Ethiopian migrants living abroad, the per capita remittance inflow is estimated to be about 100 USD per month. This is very small relative to other countries. However, it may be due to the remittance inflow through the formal system is under estimates the total inflow to the country.

Cognizant of this problem, the National Bank of Ethiopia issued a directive (FXD/30/2006) to: (i) improve the operation of the formal remittance transfer system and (ii) to enhance incoming remittance transfers and regulating processes. Following this policy initiative, some positive developments have been seen from 2006 onwards (see Figure 1).

Remittance is not the only means that Ethiopia could benefit out of its huge number of migrants. Skilled Ethiopians could contribute to the country's poverty reduction endeavor by filling the gaps in areas like education and health. In this regard, the International Organization of Migration (IOM) initiated two projects: Return and

Reintegration of Qualified African Nationals (RQAN) and Migration for Development in Africa (MIDA). The United Nations Development Program (UNDP) participate in this effort by placing a National United Nations Volunteer Program.

Figure 1: Flow of formal and informal remittance



Source: National Bank of Ethiopia

The Ethiopian government established an office called Ethiopian Expatriate Affairs under the Ministry of Foreign Affairs in January 2002 (WWW.MoFA.gov.et). The main duties and responsibilities of the office is: (i) to provide accurate information to Ethiopian migrants, and (ii) to conduct research on how to engage the Diaspora in the development of the country. However, the outcome of this initiative is not satisfactory because there are migrants who left the country for political reason and they may not be happy on policies and strategies of the current regime. Hence, to fully benefit out of the accumulated human and financial capital of migrants, the government should create an inclusive institutional framework which allows all participates with different ideologies and views.

The policy framework in Ethiopia regarding migration is very weak. There is no distinct migrant policy except the Private Employment Agency Proclamation of the Ministry of Labor and Social Affairs that only deals with agencies that facilitate employment of Ethiopians abroad (Proclamation No 104/1998). The motivation of the proclamation itself concerns the protection and safety of Ethiopians sent and employed abroad.

This proclamation stipulates the preconditions necessary to obtain a license to establish an agency that facilitate employment of Ethiopians abroad. It also requires the agency to establish an office in Ethiopia and a branch in the country it intends to send the workers. Regarding the worker the Ministry obliges the agency that it has to give proper orientation to the worker before the contract is signed; facilitate remittance of earnings according to the law of the country of work; annually report to the Ministry about the condition of the worker; keep appropriate records of the worker; and upon termination of work contract notify the nearby embassy about the condition of the worker. The proclamation also clearly states that the work should fulfill the minimum conditions of work given in the Ethiopian Law. With regards to Penalties, the proclamation states that whosoever engages in illegally transferring people without a license will be face imprisonment of up to 10 years and a fine up to 25,000 Birr. In the case where the rights of the Ethiopian have been violated in the country of work the punishment could extend to up to 20 years of imprisonment and a fine of 50,000 Birr.

Other than this proclamation that deals with employment agencies there is no specific policy or strategy that officially guides the government regarding migrants.

2. The CGE model remittances

The Computable General Equilibrium, as its name implies, is a general equilibrium model that is used to analyze the impact of shocks or policy in the different institutions and sectors of an economy simultaneously. This is done by building the behavioral interrelationships of the different sectors in an economy and simultaneously solving these equations using certain closures until the model converges. After the convergence it is possible to see the adjustment of different variables to get back to equilibrium thereby revealing the impact of a shock or policy.
In order to do this, the paper uses the Standard Model published by the International Food Policy Research Institute (IFPRI) to see the impact of a possible increase in remittances arising out of good policies on the different sectors and institutions in the economy. This model uses the 2005/06 Social Accounting Matrix prepared by Ethiopian Development Research Institute (EDRI). Because of the time constraints the simulation would be a static one.

The Standards IFPRI CGE model has major blocks including, activities block, institutions block, commodities block, macro balances. In the activities block the production technology is specified by a constant elasticity of substitution production function. Institutions include households, enterprises, factors, government and rest of the world. Commodities block is a collection of consumption goods aggregated in consumption by a CES function. The macro balances include a series of choices for the model to have a closure. These closures include government closure, saving-investment closure, rest of the world closure and price closures. By adjusting these closures it helps to see the different results under different structures of the economy.

These closures also help the model as adjustors in the presence of shocks and return the model to the equilibrium position.

Remittances or private transfer is considered under the system constraints block which includes the current account of the balance of payments. It is an exogenous variable in the model which affects the current account. In addition the model also considers it when stating the income of non-government institutions that get transfers from the rest of the world. The model is thus used to simulate the growth of remittances given possible incentives.

So the relevant equations in the model that directly involve transfers are;

i. Income of Domestic Nongovernment Institutions

$$YI_i = \sum_{f \in F} YIF_{i\,f} + \sum_{i' \in INSDNG'} TRII_{i\,i'} + trnsfr_{i\,gov} \cdot \overline{CPI} + trnsfr_{i\,row} \cdot EXR$$

$$\begin{bmatrix} \textit{income of} \\ \textit{institution } i \end{bmatrix} = \begin{bmatrix} \textit{factor} \\ \textit{income} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{from other domestic} \\ \textit{non-government} \\ \textit{institutions} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{from} \\ \textit{government} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{from} \\ \textit{RoW} \end{bmatrix} \quad i \in INSDNG \quad (30)$$

where

$i \in INSDNG(=INSDNG' \subset INSD)$

= a set of domestic nongovernment institutions,

YI_i = income of institution i (in the set INSDNG), and

$TRII_{ii'}$ = transfers from institution i' to i (both in the set INSDNG).

And CPI – Consumer Price Index

EXR – Real Exchange Rate

This equation assumes that domestic nongovernment institutions get their income either from factors, or transfers from similar other non government domestic institutions, or transfers from the government multiplied by the price index and finally transfers from the rest of the world of course valued in domestic currency.

ii. Current Account Balance

$$\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row\,f} = \sum_{c \in CE} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i\,row} + \overline{FSAV}$$

$$\begin{bmatrix} import \\ spending \end{bmatrix} + \begin{bmatrix} factor \\ transfers \\ to\ RoW \end{bmatrix} = \begin{bmatrix} export \\ revenue \end{bmatrix} + \begin{bmatrix} institutional \\ transfers \\ from\ RoW \end{bmatrix} + \begin{bmatrix} foreign \\ savings \end{bmatrix}$$

where

$\overline{FSAV}$ = foreign savings (FCU) (exogenous variable).

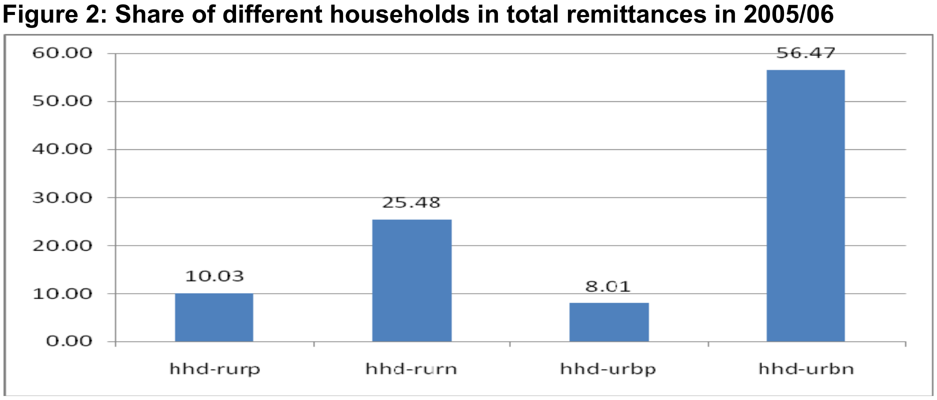
FCU is Foreign Currency Unit

This current account balance shows that import spending is financed by exports, transfers from the rest of the world and foreign savings.

Secondary impacts would arise depending on the closure and depending on the effects of income and current account balance on other variables.

Remittances in the SAM: The transfers to the household institutions take different shares. Urban non-poor households get close to 56 percent of total remittances. This is reasonable since it is the urban non-poor who usually get the exposure and resources to send their family members abroad thereby increasing the prospects of remittances. In the Ethiopian case what is considered remittances is the private transfer non-resident Ethiopians make to their relatives in the country. Rural non-poor follow with 25.5 percent share in turn followed by rural poor with 10 percent share.

Figure 2: Share of different households in total remittances in 2005/06



Source: Social Accounting Matrix

Simulation Scenarios: The simulation scenarios are designed to replicate the actual growth of remittances in 2005/06 as a base scenario and then by alternatively increasing the share of urban and rural households as recipients of the transfers.

Scenario 1: The first scenario of the model is designed primarily based on the actual increase of remittances during the 2005/06 fiscal year where the SAM data is compiled. The purpose of this scenario is to simulate what kind of impact that specific increase had on the income of different level of households. This is considered a semi-base scenario in the sense that further policy measures are likely to bring more impact. During 2005/06 remittances as measured by private transfers in the balance of payments grew by a significant 27 percent. Therefore the first scenario considers a 27 percent increase in remittances for all types of domestic non-government institutions.

Scenario 2: The second scenario is designed based on the idea that the majority of remittances go to urban non-poor and most of the growth in remittances goes to urban non-poor. Of course this scenario is expected to yield increased income inequality. Therefore, the second scenario will assume a 32 percent increase in the remittances to urban non-poor households and a much lower growth of remittances to the other households (10 percent for urban poor, 20 percent for rural poor and 22 percent for rural non-poor). The weighted average of the growth gives the actual 27 percent growth in total remittances for that year.

Scenario 3: The third scenario assumes international shocks that have the effect of reducing the growth of remittances to the country. For instance in 2008/09 the growth of remittances declined to only 13 percent from 78 percent in 2007/08. This declined in the growth of remittance is assumed to be because of the financial and economic crisis during the year. This impact could undermine planning using remittances both for households and for the macro-economy. Accordingly the 13 percent growth in remittances in 2008/09 is repeated here by adjusting the growth of remittances for the different households. With regards the growth of remittances to each household, this scenario assumes that the remittance going to poor households and urban households. Accordingly, the scenario assumes 17 percent growth for urban non-poor households, 9 percent growth for both types of rural households and 5 percent growth for urban poor households.

Closure: Having completed the framework of the scenarios there is another important part of the model that requires deciding; the closures. As the model is a general equilibrium model there are parts of the model that complete it by adjusting for the disequilibrium in the model. It is important to choose the closure that most appropriately symbolizes the structure of the economy. In the standard model there are 4 types of closures. These include, the numeraire, saving investment closure,

closure for the rest of the world, and government closure. As a numeraire we have the producer and consumer prices indices. By fixing one of them and allowing the other to adjust the closure will be set. Similarly for the saving investment closure, it is either making saving investment driven which is fixing investment or make investment saving driven which is fixing saving. For the rest of the world closure exchange rate and foreign saving are there as a choice. And finally on the government closure there are direct taxes and government savings are the two used for the closure.

For the case of Ethiopia the combination of closure initially selected considers the country as a place where the CPI, foreign savings and government savings as flexible and investment is driven by savings and considers exchange rate, producer price index, direct taxes and investment as fixed. This is a reasonable assumption for the current structure of the economy. Its consumer price index that is more flexible than the producer price index. The exchange rate is almost fixed with periodic devaluations by the central bank that uses foreign exchange reserves to maintain the exchange rate at a particular rate. Since tax rates are not easily be increased or affected they are assumed to be fixed and the government sets its savings based on the amount of collections it will have. As with most developing countries shortage of savings constrain investment thereby the saving driven investment closure.

5. Results of the simulations

The simulation is done using GAMS software. The program produces the results in different formats. It also generates some built in tables including the macro-economic table that shows the macro-economic impact of the simulations. Similarly the results of this simulation is presenting by bringing in some of the impacts of increasing remittances on the macro-economy, income of households, production and prices in certain commodities. All the scenarios are prepared based on two types of closures by changing the rest of the world closure. For closure 1 we assumed the exchange rate to be fixed and foreign savings adjusting while in the second closure it is the reverse.

Scenario 1: As described above this scenario assumes an equal increase in remittances to all households by 27 percent. The growth is taken from the actual increase in remittances in 2005/06. The different results for this scenario are presented below.

Table 1: Macro Economic Results

Closure 1				
	Base	Scen. 1	Scen. 2	Scen. 3
QABSTOT	158.8	0.3	0.3	0.2
QHTOT	114.8	2.1	2.0	1.0
QINVTOT	28.2	-6.8	-6.3	-2.8
QGTOT	15.9	0.0		
QETOT	16.8	-2.6	-2.4	-1.2
QMTOT	46.9	0.3	0.4	0.3
REXR	93.4	-0.1	-0.1	
PDIND	107	0.1	0.1	
CPI	100	0.9	0.8	0.4
INVGDP	21.3	-2.4	-2.2	-1.1
PRVSAVGDP	11.7	0.4	0.4	0.2
FORSAVGDP	8.3	-2.8	-2.7	-1.3
TRDDEFGDP	37.2	0.4	0.4	0.3
GOVSAVGDP	4.1		0.1	0.1
DIRTAXGDP	3.1	0.1	0.2	0.1

Closure 2				
	Base	Scen. 1	Scen. 2	Scen. 3
QABSTOT	158.8	2.9	2.8	1.4
QHTOT	114.8	3.6	3.5	1.8
QINVTOT	28.2	1.4	1.5	0.8
QETOT	16.8	-9.8	-9.4	-4.8
QMTOT	46.9	5.5	5.5	2.7
REXR	93.4	-3.7	-3.5	-1.8
NEXR	100	-3.8	-3.7	-1.8
PDIND	107	-0.1	-0.1	-0.1
CPI	100	-0.7	-0.8	-0.4
INVGDP	21.3	0.1	0.1	0.1
PRVSAVGDP	11.7	0.3	0.3	0.2
FORSAVGDP	8.3	-0.3	-0.3	-0.2
TRDDEFGDP	37.2	2.0	2.0	1.0
GOVSAVGDP	4.1		0.1	0.1
DIRTAXGDP	3.1	0.1	0.2	0.1

As can be seen from the result, remittances have positive impact for the macro-economy as a whole. Overall absorption and private consumption increase although especially in the second closure where the exchange rate is flexible.

For the first closure investment declines as foreign savings declines to adjust for the increase in the flow of foreign exchange in order to keep the currency from appreciating. As consumer prices domestically slightly increase under this closure due to the increase in income, there is a shift of goods from the export market to the domestic market slightly hurting exports. This causes trade deficit to increase. The increase in income of course causes the government to earn more tax.

For the second closure the exchange rate is flexible and the additional foreign exchange causes the exchange rate to appreciate. This appreciation causes exports to decline significantly even more than the case in the first closure. In contrast to the first closure prices actually decline here since the appreciation in exchange rate makes imported items cheaper in the market and the shift of exports to the domestic market increases the supply of goods and services. Obviously the trade deficit increase at a much larger rate compared to the first closure.

In general the macro-economic benefit of remittance is mixed but levels of income and consumption benefits will be maximized under a flexible exchange rate system. This being said however the flow of remittance will have a Dutch disease impact under the second closure by significantly reducing the exports and increasing the imports. It should be noted here that the model assumes the fulfillment of Marshall-Learner Condition which has magnified the impact of exchange rate on trade. Further exercises should be made here using different elasticities in the model.

The other variable directly affected by remittances is the income of households. As expected income of all households for all the scenarios and closures increases because of increases in remittances. However, the extent of the increase is different for the different scenarios and closures.

Table 2: Income of Institutions

	Closure 1			
	Base	**Scen. 1**	**Scen. 2**	**Scen. 3**
hhd-rurp	24.8	2.3	1.7	0.8
hhd-rurn	73.1	1.3	1.0	0.4
hhd-urbp	5.0	7.3	2.9	1.4
hhd-urbn	30.0	7.6	9.1	4.8
	Closure 2			
	Base	**Scen. 1**	**Scen. 2**	**Scen. 3**
hhd-rurp	24.8	1.9	1.4	0.6
hhd-rurn	73.1	1.5	1.2	0.5
hhd-urbp	5.0	6.0	1.8	0.9
hhd-urbn	30.0	6.9	8.3	4.5

Source: GAMS Output

In the first closure over all incomes for all the households increases much higher than the second closure. The incomes in the second closure increase by a smaller percentage because of the assumption that trade actually responds to exchange rate changes. Although remittances have increased the appreciation in exchange rate causes exports to fall so hard that incomes as a whole fall.

Another issue in regarding income is that most of the growth in income goes to the the non-poor households thereby posing its own problem on income distribution. In all the cases urban non-poor gets the biggest percentage increase in income showing that if remittances were to increase income inequality will increase calling for measures by the government.

Table 3: Level of domestic activity

Closure 1					Closure 2				
	Base	Scen. 1	Scen. 2	Scen. 3		Base	Scen. 1	Scen. 2	Scen. 3
ateff	5.2	2.2	2.1	1.1	ateff	5.2	3.2	3.0	1.6
amzwh	9.6	0.7	0.6	0.2	amzwh	9.6	0.9	0.8	0.4
antag	21.2	0.4	0.3	0.1	antag	21.2	0.6	0.5	0.2
axcrp	11.0	-0.8	-0.7	-0.3	axcrp	11.0	-3.6	-3.4	-1.7
alive	18.0	0.7	0.7	0.3	alive	18.0	0.2	0.2	0.1
afood	7.5	0.5	0.5	0.3	afood	7.5	0.4	0.4	0.2
achem	1.6	0.0	0.0	0.0	achem	1.6	-0.8	-0.8	-0.4
amach	0.5	-0.5	-0.4	-0.2	amach	0.5	-1.0	-0.9	-0.4
aoman	8.3	-0.7	-0.6	-0.2	aoman	8.3	-1.3	-1.2	-0.6
acons	22.0	-5.9	-5.5	-2.5	acons	22.0	1.3	1.4	0.7
autil	3.3	0.4	0.5	0.3	autil	3.3	0.7	0.7	0.4
atrad	44.1	-0.1	-0.1	0.0	atrad	44.1	-0.4	-0.4	-0.2
apsrv	17.9	0.1	0.1	0.1	apsrv	17.9	0.0	0.0	0.0
agsrv	17.1	0.2	0.2	0.1	agsrv	17.1	0.1	0.1	0.1

Source: GAMS Output

With regards to the level of domestic activities there is a shift in production away from export products to domestically produced products. For both closures the level of domestic income has increased and therefore domestic demand has increased. Of course for the first closure this impact is smaller considering exchange rate is fixed and foreign saving is the one adjusting. However, for the second closure the shift in production is really dramatic. Production of teff has increased by more than 3 percent in second closure. On the other hand the production of export crops has declined by that much in the second closure. The following table shows the impact of the remittance increases on the production sector.

6. Conclusion

International remittances have grown to be important to the Ethiopian Economy over the past few years. It is really important to understand the impact of the growth of remittances in order to have an informed policy towards migrants to the country. So far no specific policy exists that deals with migrants specifically. In order to have a policy that is well thought out and empirically informed policy it is instrumental to look at the benefits of remittances. Not much has been done on the impact of remittances in the Ethiopian case at least not recently.

The purpose of this paper is to see the overall impact of remittance increases to the Ethiopian economy in a general equilibrium manner. Along the way it also simulates what the possible impact would be if policy measures are taken to improve the inflow of remittances and the possible damage in cases of crisis.

The study uses the CGE model developed by the International Food Policy Research Institute (IFPRI) using mathematical software called GAMS that would do the solution. Remittances in the model are included under the income part and the current account of the balance of payments. Three different scenarios and two different closures were used to do the simulations. The first scenario includes an equal increase in remittance for all households. The second and third scenarios assume different increase in remittances for different households with special attention to the major recipients of remittances. Similarly the first closure assumes that foreign saving adjusts for equilibrium while exchange rate is fixed. The second closure makes exchange rate flexible.

Under this setting it can be seen from the results that overall absorption increased because of remittances as expected. However, investment declines for the first closure since the foreign savings will decline. The second closure on the other hand brings out a result that resembles the Dutch Disease in the presence a relatively responsive export and import. Of course this assumption is a bit too bold considering a country with primary exports and essential imports. Thus further exercise should be made using different elasiticities.

With the exception of depressing exports and increasing income inequality remittances have positive impact in the economy by increasing overall income and by stimulating the economy. Therefore, measure should be in place to further incentivize migrants to send more remittances.

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THE IMPACT OF SKILLS TRAINING PROGRAMME ON EMPLOYMENT CREATION AND INCOME GENERATION: A STUDY IN THE CENTRAL PROVINCE OF ZAMBIA

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Abstract

The government of Zambia has a vision to make the country one of the prosperous middle income countries by 2030. It has been implementing national development plans to this effect. The economy has recorded impressive growth over recent years. Nothing that this growth has not been translated into-broad based wealth and employment creation; government enacted Community Development Policy and has undertaken various community empowerment measures including skill trainings to help eradicate poverty among the disadvantaged groups of the society. This paper aims at assessing the impact of the training program on the creation of job opportunities and changes of welfare of the target groups with the motive to suggest policy ideas for further intervention. This program has enabled most of the beneficiaries to get employment, generate income, improve their food security status and improve wellbeing in different dimensions of welfare. Thus, this program should continue and replicated to a larger section of the society so that the rapid growth in the economy would become broad based and all inclusive.

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1. Introduction

The main objective of the National Vision 2030 is to make Zambia a prosperous middle income country by 2030. The theme of the 5th National Development Plan (2006-2010) is achieving Broad-Based Wealth and job creation. The Zambian Economy has recorded an impressive growth over recent years but this positive development is yet to translate into Broad-Based Wealth and Employment creation. Wealth creation is limited to a minority of the population particularly in the urban areas, and income in-equalities are rising.

The Fifth National Development Plan notes that the improved economic performance since 1999 has not significantly reduced poverty, due to weak linkages between the capital intensive sectors which have driven growth and the rest of the economy. The growth has not led to increase in employment opportunities. The slow growth in employment opportunities holds back human development, perpetuates in-equality, increases poverty and limits the prospects for achieving the Millennium Development Goals. Creation of employment is one of the four pillars of Zambia Decent Work Country Program.

According to the Living Conditions Monitoring Survey Report (2002-03) there is uneven distribution of income with 50 percent of the Zambian population claiming only 15 percent of the total income, while the top 10 per cent claims 48 percent of the total income which is more than three times the income share of the 50 percent population. Within the rural areas, 50 percent of the population claims 22 percent of the total income, while 10 percent claim 33 percent or 1.5 times the income share of the 50 percent rural population. In urban areas, 50 percent of the population received 12 percent of total income, while 10 percent received slightly more than half of the total income (51 percent).

According to the mid-term review of the Fifth National Development Plan (2009) Zambia has experienced sustained positive economic growth averaging 5 per cent since 1999 which has mainly been due to growth in mining and quarrying, construction, manufacturing as well as transport, storage and communication sectors. This pattern of growth has had little positive effect on the income levels of the poor who significantly depend on agriculture that is outside those that performed better. Despite Zambian GDP per capita increasing from US$ 635 in 2005 to US$ 934 in 2007, this positive growth has not translated into a significant reduction in poverty levels. Moreover, income distribution continues to be skewed as the Gini-coefficient stood at 0.60 in 2006.

The Fifth National Development Plan targets to increase spending on education and skills development to 22.4 per cent by 2010, from 16.3 per cent achieved in 2006. The proportion of the domestic budget spending on education and skills development in 2007 and 2008 were 22.7 per cent and 19 per cent, respectively.

The Living Conditions Monitoring Surveys (LCMS) conducted from 1991 to 2006 have shown that the incidence of poverty has reduced over the years. The results show that the incidence of poverty declined from 70 per cent in 1991 to 64 per cent in 2006. The gains of this reduction can be noticed in rural areas, where the incidence of poverty decreased from 88 percent in 1991 to 78 percent in 2006. In contrast, the incidence of poverty in urban areas increased from 49 per cent in 1991 to 53 percent in 2006.

The incidence of poverty decreased between 1991 and 2006 in almost all the provinces except in Central, North-Western and Western. The Western province consistently emerged as the poorest province in all the six surveys. In fact the incidence of poverty in the Western Province remained the same (84 percent) in 1991 and 2006.

Table 1: Incidence of Poverty by Province in Six Surveys of LCMS

Province	1991	1993	1996	1998	2004	2006
Central	70	81	74	77	76	72
Copperbelt	61	49	56	65	56	42
Eastern	85	91	82	79	70	79
Luapula	84	88	78	82	79	73
Lusaka	31	39	38	53	48	29
Northern	84	86	84	81	74	78
North-Western	75	88	80	77	76	72
Southern	79	87	76	75	69	73
Western	84	91	84	89	83	84

Source: C.S.O Living Conditions Monitoring Surveys (1991, 1993,1996,1998,2004 and 2006).

The proportion of the unemployed among persons aged 12 years and above for the nation was 14 percent. At national level, 13 percent of the males and 15 percent of the females were unemployed. Urban areas recorded higher unemployment rates (32 percent) than rural areas (5 percent). Copperbelt and Lusaka provinces recorded higher unemployment rates than the other provinces with 31 percent each.

The mean monthly income for a Zambian household in 2004 was K 511,377. The nodal income group for the country ranged from K 150,001 – K 300,000, representing 26 percent of the population. Only about one in every three households (35 percent) had a mean monthly income that exceeded K 300,000; implying that the majority of Zambian households, or approximately 65 percent, had incomes below the basic needs basket.

There is an acute shortage of livelihood skills in Zambia especially among the less privileged persons who have had an adverse effect on their participation in national development. Income generation activities, self-help employment and livelihood skills and entrepreneurship development are among the programmes that have proved successful in empowering the less privileged persons especially the poor, low income groups of people living in urban, peri-urban and rural areas.

Provision of relevant skills is an important and essential tool in the overall development of a country. It is when people are equipped with relevant skills to transform their environment that a country can achieve a higher level of national development.

The Priority Survey II states that 70 percent of the people in Zambia, out of which 90 percent were women, were unable to meet their basic needs of life and it is hoped that through provision of livelihood skills would help to mitigate the impact (Govt. of Republic of Zambia, Gender Policy, 2000). The Evolution of Poverty (CSO 1997) states that although poverty affects both males and females, the women were more affected due to the fact that it adds onto their already greater burden of child bearing and nurturing care giving for all the family members.

Zambia is a signatory to many Charters of the United Nations such as UNESCO which promotes among other things non-formal education and skills training. The Community Development Policy addresses the issues of human growth and development necessary for liberation and realization of the individual potential and capacity to contribute to national development. Skills development and training, therefore, must be viewed as instruments to eradicate poverty.

The Skills Training Programme is concerned with the provision of livelihood skills for income generation ventures such as Home Management, Carpentry and Joinery, Fabric Printing, General Agriculture, Metal work, Tailoring and Design and Brick laying and Plastering. The purpose of the programme is to equip the trainees with knowledge, skills and attitudes in each of the trade to enable them to perform in both the formal and informal sectors of the economy. This programme normally targets those people who have never been to school but have attended literacy classes and are able to read and write in local languages and are able to do simple arithmetic as well as early school dropouts.

The vision of the Government of the Republic of Zambia with regard to community development is poverty eradication through empowerment of communities for sustainable human development (Community Development Policy, 2003). This vision can therefore be effectively and efficiently facilitated by the provision of socio-economic empowerment of the less privileged poor and vulnerable and promote the development and preservation of culture for sustainable human development.

In implementation of the Skills Training Programme, the Government works with the Catholic Church which is spearheading the programme where the Government has got no institutions. The Government has 13 provincial training centers which are official government institutions in providing such training. These centers are located in all the 9 provincial headquarters and in some districts. This programme is being implemented by the Ministry of Community Development and Social Services.

The total budget for the education and skills development sector in 2006 was K 2,043.4 billion. The total government allocation for the Ministry in that year was K 1,273.2 billion while government released to the sector in 2006 a total of K 1,269.6 billion (Mid-term review FNDP, 2009). Under the economic empowerment programmes, the main activities included non-formal education and skills training and women development, food-security pack distribution and infra-structure rehabilitation. Table (2) shows the budget allocated to the Provincial Community Development Department during 2008.

Table 2: Budget for Community Development of Provinces in 2008

No	Provinces	Budget (in Million Kwacha)	Trained People
1	Lusaka	71.5	231
2	Copperbelt	198.7	00
3	Central	204.2	222
4	North	176.9	00
5	Western	10	2118
6	Eastern	185.3	1695
7	Luapula	53.7	00
8	North - Western	162	500
9	Southern	183.3	1086
	Total	1245.7	5852

Source: FNDP Mid-term review, Ministry of Finance and National Planning, 2009.

The objectives of the study are:

1. To investigate the impact of this programme on employment creation, income generation, food security and social security with respect to different types of skills.
2. To find out the changes in profession due to skills training.
3. To examine the effect of duration of skills training on employment and income.

2. Review of literature

2.1. Theoretical literature

Skills development refers to the outcomes of the learning process without reference to the source of skills acquisition (World Bank, 2004 a). Skills development has a wider definition and focuses on learning and skills acquisition (Morel, 2004).

According to King and Palmer (2006) skills development does not refer to the curricular or programme source of education or training itself but to the productive capacities that are acquired through these skills courses and programmes. The acquisition of these capacities is dependent on many factors, including good quality education/training and the presence of a supportive environment. But the utilization of these capacities requires other facilitative infrastructure.

The World Bank (1980) stated that the skills development should be looked as complementary inputs into an over-all national training programme. Training in the rural and urban informal sectors can improve the productivity of the poor if it is used to complement broaden strategies to generate income, but training alone has not been very effective (World Bank, 1991).

Training by itself will not create jobs, even within the huge informal sector; improved training will not be effective on its own. Series of other business development interventions including micro-credit, market access, security of tenure, and improved infrastructure need to support the enabling environment within which improved skills and technologies can be utilized (King and Palmer, 2006).

ILO has rightly pointed out that poverty elimination is impossible unless the economy generates opportunities for investment, entrepreneurship, job creation and sustainable livelihoods. The principal route out of poverty is work. The ILO's "working out poverty" document stresses that skills are essential to improve productivity, incomes and access to employment opportunities (ILO, 2003). The World Bank (2004 a) recognized the importance of skills training for poverty reduction and growth. It has suggested for investing in skills training in Sub-Saharan Africa. Globalisation and competition require higher skills and productivity among workers, both in modern companies and in the micro and small enterprises that support them. In many countries in Sub-Saharan Africa technological changes require richer cognitive content, higher skills levels in the labor force, and continued enhancement of work force skills. A labor force with a solid basic skills foundation is essential for countries to exploit the opportunities opened by technological change. Skills are an important means to increase incomes and sustainable livelihood for the poor.

Investing in the productivity and skills of economically and socially vulnerable groups is essential for poverty reduction is one of the main messages of “Can Africa claim the 21st Century?” (World Bank, 2000a).

The World Bank’s Education sector strategy update entitled, “Achieving the MDGs, Broadening our perspective, maximizing our effectiveness”, highlights the importance of skills training for poverty reduction in the informal economy. (World Bank, 2005 b: 9).

Skills training in the informal economy increases productivity, quality, diversity and occupational safety and improved health, thereby increasing incomes and hence leading to reductions in poverty level for these workers and their families. The importance of skills training for the informal sector is rooted in the need to enhance productivity of informal sector activities and improve the quality of its products and services, in order to raise the incomes of those employed in the sector (World Bank 2004 a: 128).

Assad (1993) argued that skills training helps to develop social capital. Training allows for a gradual building up of informal business networks (with suppliers, customers, other apprentices and masters). Hart (1973) pointed out that skills training will strengthen informal social networks and knowledge about informal sector associations and contacts.

Fluitman (1994) assured that the skills training helps in developing business skills and experience. Training in the work place results in experience in and the development of general business and managerial skills including customer relations skills, crucial to apprentices’ future survival as independent entrepreneurs.

Mc Grath (2005) advocated skills development for rural development. Korboe (2001 a) pointed out that combination of training and providing tools to graduates would be sufficient to generate self employment.

Fluitman (2002) remarked that there is definite link between skills training and poverty reduction and argued that skills training is good for growth, productivity and innovation.

Palmer (2004 b) revealed that skills training in non-farm activities that results in increased productivity might lead to knock-on effects to agricultural enterprises, principally through cross financing.

2.2. Empirical evidence

Skills Training and Entrepreneurship Programme (STEP) in Ghana :(Government of Ghana, 2005): In 2001, STEP, a government supported training programme was started to reduce poverty by providing employable skills to the unemployed. This programme is funded by allocations from the HIPC fund. STEP has three principal components. Firstly, skills training delivered through vocational training providers. By March 2005, about 25000 unemployed have undertaken STEP training through formal public and private training providers. STEP training courses run for three to twelve months in 58 training areas, from textiles and soap production to welding, carpentry and painting.

Secondly, skills enhancement for master-craftsmen and skills training through apprenticeship placements has been undertaken up to 12 months. Thirdly, there was a micro-finance component launched in 2004, to provide working capital to enable those trained under STEP to set up their own enterprises.

Vocational Skills & Informal Sector support project in Ghana (Korboe, 2001 a): The World Bank Vocational Skills and Informal Sector support Project (VSP) was implemented during 1995-2000, on skills upgrading for master craftsmen and traditional apprentices as a means to improve productivity and reduce poverty among participants. The VSP trained 14,565 apprentices (against a target of 15000) in five trades in 39 selected public and private institutions. Under VSP 9304 masters received technical training and 7666 masters benefited from entrepreneurship training.

Community – based Training in Cambodia (ILO, 2003): An ILO/UNDP project on vocational training for the alleviation of poverty trained over 8000 women and men in a diverse range of skills from 1993 to 1999. Follow-up surveys over the 12 months after completion of training showed that 82 percent of trainees had work using their new skills and were earning US$ 33 a month on average, well above the average per capita GDP of about US$ 22 a month. Many were un-skilled farm workers, often having little or no cash income prior to participating in the project.

A number of other countries have launched projects and programmes based on the ILO community-based training approach, including Azerbaijan, Bangladesh, Belarus, China, Jamaica, Kenya, Nepal, Nigeria, Pakistan, Phillippines, the Russian Federation, Sri Lanka, United Republic of Tanzania and Uganda.

Training for Rural Economic Empowerment (TREE) in Pakistan and the Phillippines (ILO, 2005): The ILO TREE project (2002-2005) funded by the U.S.

Department of Labor aimed to expand economic opportunity and income security through work force education, skills training, employment creation and local economic development for the most marginalized groups in diverse, geographical areas in Pakistan and the Philippines.

In Pakistan by March 2005, 1602 people (39% female, 61% male and 61% youth) have been trained in 49 different disciplines. Another component to the TREE project in Pakistan involves organizing saving and credit groups and business associations. 127 saving and credit groups have been organized, out of which 64 are female and 63 are male groups. These groups have been linked with micro-finance services of National Rural Support Programme. 189 beneficiaries have availed credit amounting to Rs. 1.929 million, with a 100 percent loan recovery rate.

Follow-up on 1148 individuals who received vocational skills training revealed that 935 have confirmed employment/self employment (81%). There are only 48 trainees who are not utilizing their skills.

In Philippines, the TREE project involved both skills and entrepreneurship development training and organizing corporate community groups and community funds scheme. As of March 2005, the project trained 725 beneficiaries in vocational and entrepreneurial skills. Follow-up surveys revealed that on average 85% participants in TREE programme are utilizing their skills acquired for income generation (91% men, 82% women and 63% youth).Some had increased their average monthly incomes by up to 80 percent.

Chile Joven in Latin America (Brewer, 2005): “Chile Joven” project was started during the 1990’s to train the young people in Latin America. Between 1991-2001 period 164000 persons were trained. There is direct linkage of beneficiaries with the labor world due to the practical nature of the training model, positively changed their motivations and attitudes vis-à-vis work, training and education in general.

In Argentina, impact on earnings was statistically significant for young males and adult females. The estimated impact on employment was statistically significant for adult females only.

Vocational Education Reform project in China (World Bank, 2003): The World Bank funded “Vocational Education Reform Project” was implemented during 1996-2002. The aim of this project was to improve and increase the supply of skilled labor to meet labor market demands, raise the quality and efficiency of the vocational education and training system and build up capacity for monitoring, evaluation and dissemination of pilot experiences and replication. To achieve these objectives a two-pronged approach was taken, (i) the development of 80 key secondary vocational and technical schools as models for up grading the quality and efficiency of vocational education and (ii) improving and planning and management of vocational education.

The appraisal projection of enrolment increase from 42000 to 60000 in full-time pre-employment courses over the project period was far exceeded in reality. 91% found employment within six months of graduation.

3. Methodological framework

The study used two-stage random sampling technique to collect data. In the first stage two districts were selected from the Central Prince and in the second stage the beneficiaries belonging to different skills were selected randomly. Out of the 9 provinces in Zambia, the Central Province was selected for the present study as it was one of the poor provinces. The Central Province was divided into 6 districts. They are: Chibombo, Kabwe, Kapiri Mposhi, Mkushi, Mumbwa and Serenje. Out of the six districts of Central Province, two districts – Chibombo and Kabwe – were selected for the present study. From Kabwe district 136 beneficiaries – 100 beneficiaries from 18 peri-urban and rural villages– and from Chibombo district 24 beneficiaries from 9 peri-urban and rural villages, thus a total of 160 beneficiaries were randomly selected.

The impact on employment creation was measured by comparing the number of days worked in a month before and after training. The impact on income generation was measured by comparing the income in a month before and after training. The impact on food security was measured on the basis of number of times a day family members ate and also the quality of food. The impact on social security was measured on the basis of membership of any organization/association, ability to represent the social problems. The impact on the ability to send children to school and ability to take family members to hospital, when they fell sick, is measured on the basis of the situation before and after training.

The present study used the concept of below poverty line as adopted by the Department of Community Development, Ministry of Community Development and Social Service, Government of Zambia, i.e., K 800,000 per month.

4. Data analysis and findings

Change of occupation of the sample beneficiaries: Table (3) shows the change of occupation after training. Out of 160 sample beneficiaries, 89.37 per cent changed their occupation due to training.

Table 3: Change of Occupation of the Beneficiaries after Training

No	Change of occupation	Number of Beneficiaries	Percentage
1	Yes	143	89.4
2	No	17	10.6
	Total	160	100

Source: Own Calculation Based on Primary Data from the Survey.

Only 10.63 per cent sample beneficiaries were trained in their previous occupation. **Impact of Skills Training on Employment (No. of days per month):** Table (4) shows the impact of skills training on employment.

Table 4: Impact of Skills Training on Employment (Number of Days per Month)

	Skills training	Total Number of Beneficiaries	Before Training	After Training	Increase
1	Carpentry	32	5.15	23.6	18.45
2	Metal Work	14	6.64	23.92	17.28
3	Bricks laying and Plastering	26	7.84	23.2	15.6
4	Fabric Printing	11	-	17.54	17.54
5	Tailoring and Design	50	4.48	23.56	19.08
6	General Agriculture	27	1.48	25.4	23.92
	Total	160	4.26	22.87	18.61

Source: Own Calculation based on Survey Data.

The above Table (4) shows that there was positive impact of skills training on employment. The number of days of employment per month increased by more than four times in the study area and reached to 18.61 days per month. The highest increase in employment was in General Agriculture (23.92 days) and the lowest increase in employment was in brick laying and plastering skills. The number of days of employment increased due to skills training with respect to Carpentry, Metal Work, Fabric Printing and Tailoring and Design was 18.45 days, 17.25 days, 17.54 days and 19.08 days per month, respectively.

Impact of Skills Training on Income (per month): Table (5) shows the impact of skills training on income of the beneficiaries per month.

The table shows that the impact of skills training on income of the beneficiaries was positive. The average income of the beneficiaries increased by seven times due to skills training, i.e., from 96 thousand per month to 682 thousand per month. The highest increase in income was recorded in the general agriculture skill and the lowest was recorded in fabric printing skill, i.e., K1297,000 per month and K279,000 respectively. The increase in income per month with respect to Carpentry, Metal work, Bricklaying & plastering, and Tailoring and design was K 574,000, K589, 000, K 852,000 and K 499,000 respectively.

Table 5: Impact of Skills Training on Income per month (in '000 Kwacha)

No	Skills	Before	After	Increase
1	Carpentry	112	686	574
2	Metal work	132	721	589
3	Bricklaying and Plastering	173	1025	852
	Fabric Printing	---	279	279
	Tailoring and Design	59	558	499
	General Agriculture	103	1400	1297
	Total	96	778	682

Source: Own Calculation based on Survey Data.

Impact of Skills Training on Poverty: Table (6) shows the impact of skills training on poverty of the sample beneficiaries.

Table 6: Impact of Skills Training on Poverty of the Sample Beneficiaries

No	Skills Training	Total Number of Beneficiaries	Number of Poor Before	Number of Poor After	Number of Poor Reduced due to Training
1	Carpentry	32	30 (93.75)	21 (65.62)	1.09 (28.10)
2	Metal Work	14	13 (92.85)	07 (50.00)	1.06 (42.85)
3	Bricklaying & Plastering	26	26 (100)	10 (38.46)	16 (61.53)
4	Fabric Printing	11	11 (100)	10 (90.90)	01 (9.09)
5	Tailoring & Design	50	49 (98.0)	31 (62.0)	18 (36.0)
6	General Agriculture	27	25 (92.59	17 (62.96)	08 (29.62)
	Total	160	154 (96.25)	96 (60.0)	58 (36.25)

Source: Own calculation based on Survey Data (Note: Figures in the parentheses are percentages).

The above Table (6) shows that due to skills training the number of poor was reduced. Before training, 96.25 per cent beneficiaries were poor (i.e., the income per month was less than K 800,000 which is considered as the poverty line by the Ministry of Community Development, Govt. of Zambia). But after skills training their percentage came down to 60 per cent, i.e., the percentage of poor reduced due to skills training was 36.25. The reduction of poverty was the highest in Brick laying and Plastering, i.e., 61.53 percent, whereas, it was the lowest in Fabric Printing, i.e., 9.09 per cent. The number of the poor reduced due to skills training in Carpentry, Metal

Work, Tailoring &Design and General Agriculture is 09 (28.10 percent), 06 (42.85 percent), 18 (36 percent) and 08 (29.62 percent), respectively.

Impact of Skills Training on Food Security: Table (7) shows the impact of skills training on food security of the beneficiaries.

Note: Figures in the parentheses are percentages.

Table 7: Impact of Skills Training on Food Security

No	Skills Training	Total Number of Beneficiaries	Number of Times Ate Per Day Increased	Quality of Food Increased
1	Carpentry	32	22 (68.8)	32 (100)
2	Metal Work	14	8 (57.14)	12 (85.71)
3	Bricklaying & Plastering	26	20(76.9)	23(88.5)
4	Fabric Printing	11	3 (27.3)	8 (72.7)
5	Tailoring & Design	50	34 (68)	40 (80.0)
6	General Agriculture	27	22 (81.5)	21 (77.8)
	Total	160	109 (68.1)	136 (85)

Source: Own Calculation based on Survey Data. (Note: Figures in the parentheses are percentages).

Table (7) above shows that the skills training programme had positive impact on food security, i.e., the number of times ate per day and the quality of food. Out of 160 total beneficiaries, 109 (68.12 per cent) reported that the number of times they ate per day had increased and 136 beneficiaries (85 per cent) reported that the quality of their food improved.

It may be observed that the number of times beneficiaries ate per day increased with respect to all the types of skills. The percentage was higher with respect to General Agriculture (81.48 percent), Brick laying and Plastering (76.92 percent), Carpentry (68.75 per cent), Tailoring and Design (68 per cent), Metal Work (57.14 per cent) and it was lower with respect to Fabric Printing (27.27 per cent).

The quality of food increased with respect to all the types of skills training beneficiaries. It was the highest with respect to Carpentry (100 percent); in Metal Work 85.71 per cent, Bricklaying and Plastering 88.46 percent, Fabric Printing 72.72 percent, Tailoring and Design 80 percent and General Agriculture 77.77 percent.

Impact of Skills Training on Social Security: Table (8) shows the impact of skills training on social security of the beneficiaries.

Table 8: Impact of Skills Training on Social Security

No	Skill	Number of Beneficiaries	Membership of any Association after Training	Ability to Represent Social Problems after Training
1	Carpentry	32	14 (43.75)	19 (59.37)
2	Metal Work	14	02 (14.28)	07 (50.00)
3	Brick laying and Plastering	26	10 (38.46)	15 (57.69)
4	Fabric Printing	11	05 (45.45)	07 (63.63)
5	Tailoring & Design	50	16 (32.00)	20 (40.00)
6	General Agriculture	27	21 (77.77)	17 (62.96)
	Total	160	68 (42.5)	85 (53.1)

Source: Own Calculations based on Survey Data (Note: Figures in the parentheses are percentages).

It may be observed that the skills training had positive impact on social security. After training 42.5 percent beneficiaries took the membership of different Associations/Organizations. More than half of the beneficiaries reported that their ability to represent the social problems had increased after training.

The beneficiaries belonging to General Agricultural skills training were the highest who took the membership of different Associations/organizations (77.77 percent), which was an indication of social awareness. It was the lowest with respect to Metal Work skills (14.28 percent)

The percentage of the beneficiaries who took membership of Associations/ Organizations with respect to carpentry, Brick laying and Plastering, Fabric printing and Tailoring and Design was 43.75 percent, 38.46 percent, 45.45 percent and 32 percent, respectively.

Impact of Skills Training on Ability to send children to school and family members to hospital: Table (9) shows the impact of skills training on ability of the beneficiaries to send children to school and family members to hospital.

Table (9) shows that the skills' training programme has a positive impact on the beneficiaries relating to all the skills. The ability of 66.25 percent beneficiaries to send their children to schools increased and the ability of 68.12 percent beneficiaries to take their family members to hospital, when they fell ill, increased.

Table 9: Impact of Skills Training on Ability to Send Children to School and Hospital

No	Skill	Number of Beneficiaries	Increase in Ability to Send Children to School	Increase in Ability to take Family Members to Hospital
1	Carpentry	32	21 (65.62)	23 (71.87)
2	Metal Work	14	07 (50.00)	07 (50.00)
3	Brick laying & Plastering	26	14 (53.84)	15 (57.69)
4	Fabric Printing	11	08 (72.72)	08 (72.72)
5	Tailoring & Design	50	34 (68.00)	33 (66.00)
6	General – Agriculture	27	22 (81.48)	23 (85.18)
	Total	160	106 (66.25)	109 (68.12)

Source: Own Calculation based on Survey Data (Note: Figures in the parentheses are percentages).

The ability of the beneficiaries to send children to school and to take family members to hospital, when they fell ill, was the highest with respect to General Agriculture, which was 81.48 percent and 85.18 percent, respectively. The ability to send to school of 65.62 percent beneficiaries belonging to Carpentry, 50 percent of Metal Work, 53.84 percent of Brick laying and Plastering, 72.72 percent of Fabric printing, and 68 percent of Tailoring and Design increased after training.

The ability to take their family members to hospital, when they fell ill, increased by 71.87 percent of Carpentry skill, 50 percent of Metal work skill, 57.69 percent of brick laying and plastering, 72.72 percent of Fabric printing skill and 66 percent of Tailoring and Design skill.

Sources of Loan to the beneficiaries: Table (10) shows the sources of loan to the beneficiaries.

Table 10: Sources of Loan to the Beneficiaries

No	Source of Loan	Number of Beneficiaries
1	Organized Financial Institutions	
	(a) Bank	3 (1.87)
	(b) Co-operative Society	11 (6.87)
	Total (a+b)	14 (8.75)
2	Un-organized Sources	
	(c) Money Lender	4 (2.5)
	(d) Relatives	28 (17.5)
	(e) Own	114 (71.25)
	Total (c+d+e)	146 (91.25)

Source: Own Calculation based on Survey Data (Note: Figures in the parentheses are percentages).

Table (10) shows that only 8.75 percent beneficiaries had taken loans from the organized financial institutions and the source of finance for 91.25 percent beneficiaries was from the un-organized sources, like money lender (2.5 percent), relatives (17.5 percent) and own (71.25 percent).

Impact of duration of training on Employment and Income: Table (11) shows the impact of duration of training on employment and income.

Table 11: Impact of Duration of Training on Employment and Income

No	Duration of Training	Increase in Employment (Number of Days Per Month)	Increase in Income Per Month ('000 Kwacha)
1	Up to 3 Months	19.25	875.42
2	4 to 6 Months	16.21	286.78
3	7 to 12 Months	21.03	719.25
4	13 to 24 Months	20.58	714.20
5	Above 24 Months	16.33	728.33
	Average	18.61	682

Source: Own Calculation based on Survey Data.

Table (11) shows that the average number of days increased per month was 18.61 and the average increase in income per month was K 682000. The highest number of days of employment increased was with respect to training between 7 to 12 months, but increase in income was the highest with respect to up to 3 months training. The number of days of employment and income increased with respect to 4 to 6 months training was 16.21 days and K286.78, respectively. It was 20.58 days and K714.20 respectively with 13 to 24 months training and it was16.33 days and K728.33 respectively for above 24 months training.

5. Conclusions and policy suggestions

There was a positive impact of skills training on employment. The number of days of employment per month increased by more than four times in the study area, i.e., 18.61 days per month. The highest increase in employment was in General Agriculture (23.92 days) and the lowest increase in employment was in brick laying and plastering skills. The number of days of employment increased due to skills training with respect to Carpentry, Metal Work, Fabric Printing and Tailoring and Design was 18.45 days, 17.25 days, 17.54 days and 19.08 days per month, respectively.

The impact of skills training on income of the beneficiaries was also positive. The average income of the beneficiaries increased by seven times due to skills training, i.e., from K 96000 per month to K682000 per month. The highest increase in income was recorded in the general agriculture skill and the lowest was recorded in Fabric printing skill, i.e., K1297000 per month and K 279,000 respectively. The increase in income with respect to Carpentry, Metal work, Bricklaying & plastering, and Tailoring and design was K 574000, K589000, K 852,000 and K 499000 per month respectively.

Due to skills training the number of poor was reduced. Before training, 96.25 per cent beneficiaries were poor (i.e., the income per month was less than 800 thousand Kwacha, which is considered as the poverty line by the Ministry of Community Development, Govt. of Zambia). But after skills training their percentage came down to 60 per cent, i.e., the percentage of poor reduced due to skills training was 36.25. The reduction of poverty was the highest in Brick laying and Plastering, i.e., 61.53 percent, whereas, it was the lowest in Fabric Printing, i.e., 9.09 per cent. The number of poor reduced due to skills training in Carpentry, Metal Work, Tailoring &Design and General Agriculture was 09 (28.10 percent), 06 (42.85 percent), 18 (36 percent) and 08 (29.62 percent) respectively.

The skills training programme had positive impact on food security, i.e., the number of times people eat per day and the quality of food. Out of 160 total beneficiaries, 109 (68.12 per cent) reported that the number of times they ate per day increased and 136 beneficiaries (85 per cent) reported that the quality of their food improved.
The percentage was higher with respect to General Agriculture (81.48 percent), Brick laying and Plastering (76.92 percent), Carpentry (68.75 per cent), Tailoring and Design (68 per cent), Metal Work (57.14 per cent) and it was lower with respect to Fabric Printing (27.27 per cent).

The quality of food improved with respect to all the types of skills training beneficiaries. It was the highest with respect to Carpentry (100 percent), in Metal Work 85.71 per cent, Bricklaying and Plastering 88.46 percent, Fabric Printing 72.72 percent, Tailoring and Design 80 percent and General Agriculture 77.77 percent.

The skills training had positive impact on social security. After training 42.5 percent beneficiaries took the membership of different Associations/Organizations. More than half of the beneficiaries reported that their ability to represent the social problems increased after training.

The beneficiaries belonging to General Agricultural skills training were the highest who took the membership of different Associations/organizations (77.77 percent), which was an indication of social awareness. It was the lowest with respect to Metal Work skills (14.28 percent)

The percentage of the beneficiaries who took membership of Associations/ Organizations with respect to carpentry, Brick laying and Plastering, Fabric printing and Tailoring and Design was 43.75 percent, 38.46 percent, 45.45 percent and 32 percent respectively.

The skills training programme had positive impact on the beneficiaries relating to all the skills. The ability of 66.25 percent beneficiaries to send their children to schools increased and the ability of 68.12 percent beneficiaries to take their family members to hospital, when they fell ill, increased.

The ability of the beneficiaries to send children to school and to take family members to hospital, when they fell ill, was the highest with respect to General Agriculture, which is 81.48 percent and 85.18 percent, respectively. The ability to send to school of 65.62 percent beneficiaries belonging to Carpentry, 50 percent of Metal Work, 53.84 percent of Brick laying and Plastering, 72.72 percent of Fabric printing, and 68 percent of Tailoring and Design increased after training.

The ability to take their family members to hospital, when they fell ill, increased by 71.87 percent of Carpentry skill, 50 percent of Metal work skill, 57.69 percent of brick laying and plastering, 72.72 percent of Fabric printing skill and 66 percent of Tailoring and Design skill.

Only 8.75 percent beneficiaries took loans from the organized financial institutions and the source of finance for 91.25 percent beneficiaries was from the un-organized sources, like money lenders (2.5 percent), relatives (17.5 percent) and own (71.25) percent.

The highest number of days of employment increased was with respect to training between 7 to 12 months, but increase in income was the highest with respect to up to 3 months training. The number of days of employment and income increased with respect to 4 to 6 months training was 16.21 days and K 286.78, respectively. It was 20.58 days and K 714.20, respectively with 13 to 24 months training and it was 16.33 days and K 728.33, respectively for above 24 months training.

Given the above findings, the study suggests the following measures.

1. Since the skills training programme had positive impact on creation of employment, it should be continued and strengthened to solve the problem of un-

employment in Zambia. While providing training, General Agriculture, Carpentry, Fabric Printing and Tailoring & Design skills should be given preference, as their impact on creation of employment was encouraging.

2. Since the impact of skills training on income was positive and increased by seven times, this programme should be encouraged and should be given its due place in the policy formulation and allocation of budget.
3. Since the skills training programme had positive impact on reducing the below poverty line households, it should be used as a measure to reduce poverty in Zambia.
4. Since the impact on food security was the highest with respect to the general agriculture (i.e., 81.48 percent) and the impact on the quality of food was the highest with respect to carpentry (i.e., 100 percent), these skills should be given preference in providing training more with respect to General Agriculture, Carpentry and Fabric printing, these skills should be encouraged.
5. Since the ability of the beneficiaries belonging to General Agriculture, Carpentry and Bricklaying and plastering skills with respect to sending their children to school and taking their family members to hospital when they fell ill increased, these skills training should be given preference.
6. Since the sources of loan from the organized institutions are limited, the bank branches and the credit co-operative societies should be established in the study area. The activities of the money lenders should be controlled to protect the people from exploitation.
7. In Zambia, since there is scarcity of capital but more un-employment and lower income, 7to 12 months and up to 3 months training should be given as it increased the number of days of employment and income respectively.

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MAINTENANCE OF OCCUPATIONAL SAFETY AND HEALTH AT BEDELE BREWERY SHARE COMPANY

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Abstract

Safety and health of employees is a decisive factor in organizational effectiveness in terms of company's smooth and successful functioning. Hence, this study was aimed at examining the maintenance of occupational safety and health of employees in order to enhance the productivity of the company through protecting the workers against any health hazard arising out of work or conditions. With the use of stratified random sampling technique, information was collected from 90 non-managerial employees and 15 management officials. Secondary data have also been used. The study found out that the company has not managed trainings pertaining to OSH, failed to supply adequate and quality personal protective equipments and has not maintained adequate safety promotions and incentives. Hence it is advisable for the company to distinguish areas prone to frequent incidents and try to alleviate the problems of OSH. In additions to this, it is advisable for the company to equip its clinics and first aids in appropriate fashion in order to maintain effective OSH.

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1. Introduction

Health and safety of employees is a decisive factor in organizational effectiveness. It is an important aspect of a company's smooth and successful functioning. Mathis and Jackson (1997) defined health and safety as a general state of physical, mental and emotional well being.

The main purpose of effective safety programs in organizations is to prevent work-related injuries and accidents. The International Labor Organization (ILO) and the World Health Organization (WHO) share a common definition of occupational health. It was adopted by the joint ILO/WHO committee on occupational health at its first session in 1950 and revised in 1995. The definition reads: "Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the workers in an occupational environment adopted to his/her physiological and psychological capabilities; and to summarize, the adaptation of work to man and of each man to his job."[3]

The ILO (2004) estimates that more than 1.25 trillion dollars, which is equivalent to 4 percent of the world's GDP, is lost each year due to occupational accidents and diseases. According to the same report, the rate of total accidents in developing countries is four times higher than that in industrialized countries. Studies indicate that the cost of poor safety and health can be substantial. In the European Union in 2000, the cost of workplace accidents amounted to €55 billion, or the equivalent of 0.64% of the GDP for the EU-15, while an average of 1,250 million working days are being lost each year due to health problems. The Health and Safety Executive (HSE) of U.K., (2004) pointed out that, in Britain in 2001/02, the cost of workplace accidents and work-related ill health was substantial, costing employers between €5.1 and €10.2 billion, and costing individuals between €13.2 and €19.2 billion. The cost to the economy is estimated to be between €17.1 and €29.0 billion, and to society as a whole between €26.1 and €41.5 billion. Yet, researches on the occupational safety and health are very limited. According to Barling and Zacharatos (2000) and Campbell, Daft and Hulin (1982) cited in Barling Loughlin, Kelloway (2002)), revealed that less than 1% of organizational researches published in acclaimed journals are focused on occupational safety. So, compared to other elements of the human resource management (HRM) model, work place health and safety is under-

[3] Job Safety and health http://ww.en.wikipedia.org/wiki/occupationalsafetyhealth

researched and has been largely neglected in the discourse of the subject. This is one reason, together with the rising cost of health, new laws and the 'deregulatory' proposals, why HRM specialists should devote more attention and research to workplace health and safety. However, there is another important reason. If strategic management means anything, it must encompass the development and promotion of a set of health and safety policies to protect the organization's most valued asset, its employees.

In most of the cases, along with improving working conditions, many employers provide health services and have programs that encourage employees to improve their health habits. This will let the firm to be competent. On the other extreme, if firms fail to institute health and safety policies and accordingly implement them, their workers and the organizations may be exposed to very damaging risk. Thus, assessing the existence of such policies and the status of their implementation in firms dealing with some form of production activities with the help of motor driven machineries is very important to take corrective measures.

This study draws on beverage industry with particular focus on the case of Bedele Brewery Share Company. This brewery is located in Oromia region, Illubabor Zone, Southwestern Ethiopia, 483 kilometers from Addis Ababa. It was established in October 1993. As preliminary investigation made for this study indicates, most employees of Bedele Brewery strongly urge that the company should install capable fire extinguisher in the factory to prevent fire accidents without causing losses. In addition to this, those who perform their duties on some machinery blamed the company that their safety and health is liable to hazardous conditions. Employees have been facing injuries due to manual handlings. Some chemicals that are used by the company are somewhat hazardous for the employees' safety and health. On the other side, the well-being of the company is a function of having healthy and saved personalities. In light of this, a thorough study on the prevailing conditions related to maintenance of Occupational Safety and Health (OSH) in the company is needed. Such study will be an input for the company to maintain good industrial relations. Furthermore, as there are few researches conducted pertaining to this topic, this study can contribute to the scanty literature available.

Because of the facts noted above, the general objective of this study is to assess the status of maintaining employees' occupational safety and health in Bedele Brewery in terms of its effort in implementing procedures and systems of insuring safety and health condition of workers. Specifically, this study aims at appraising (1) how the company maintains safe work practices and procedures, (2) the nature of occupational safety and health training given by the company, (3) the status of safety climate in the company, (4) the use of safety materials and personal protective equipments in the company, and (5) the roles to be assumed by the company's stakeholders to minimize possibilities of potential hazards.

The remaining part of this paper is organized as follows. Section II of the paper deals with the occupational safety and health practices of organizations. Section III deals with the methodological approach used in conducting this study. Section IV presents the empirical results of the study. Section V concludes the study with essential administrative and policy interventions to uphold safety and health of employees.

2. Occupational safety and health practices

This section deals with review of related literatures pertaining to maintenance of occupational safety and health.

All workers have a right to work in places where risks to their health and safety are properly controlled. Health and safety is about protecting employees getting hurt at work or ill through work. OSH is a global concern for all employers, workers and national governments. According to estimates by the ILO, every year there are some 2 million deaths worldwide due to work-related causes. Of these some 354, 000 are due to fatal accidents. In addition, there are more than 270 million occupational accidents and 160 million work-related diseases, which affect workers every year. This huge humanitarian and financial cost requires the attention of different parties to address the underlying causes of safety and health-related parties (ILO, 2004).

A question arises as to why safety is important in organizations. All workers have a right to work in places where risks to their health and safety are properly controlled and risks of damage and illness through work will not arise.

Safety and accident prevention concerns managers for several reasons, one of which is the staggering number of work-related accidents. For example, over 5500 U.S workers died annually in the early 2000s in work places incidents, and there were over 4.7 million non-fatal injuries and illnesses resulting from accidents at work roughly. 5.1 Cases per 100 full time workers in the United States per year. Many safety experts believe such figures actually underestimate the true numbers of many injuries and accidents, as others just go unreported (Dessler, 2005)

As per research released by U.K.'s Health and Safety Executive (1999) over 80% of all injuries in the brewing industry are caused by:

A. Manual handling especially of casks, kegs, crates and heavy plant.
B. Slips and trips – 90% of slips are on wet surfaces.

C. People struck by moving objects including falls of articles – sometimes from vehicles.
D. Falls – especially from vehicles, stairs, ladders and work plat forms.
E. Vehicles – especially forklift trucks.

In additions to the aforementioned facts, the research further describes the major occupational ill health in the following fashion.

A. Back injuries from heavy manual handling e.g. of casks, kegs, crates and items of plant.
B. Noise-induced hearing loss from noisy plant e.g. packaging machinery (pegging bottling and canning lines, compressors boilers and steam plant.
C. Occupational lung disease from exposure to grain and malt dust.

Once more, the incidence rates for the brewing industry for the year 1996/1997 from official figures indicated a rate of 6.76 for major injuries and 2845 for injuries causing over three-day absences (HSE, 1999).

It is estimated that each year, there are 3 million fatalities resulting from accidents or poisoning, the majority of which occur in under developing countries. Occupational accidents, defined as those accidents that occur at the place of work, are also of major concern. Each year 180000 people are killed because of accidents at work, whilst 110 million are injured (Ringdah, 1992). According to data collected in 1988, Hayos and Zimolong (1988, cited in HSE (1997)), in the U.S.A a fatal accident occurs every 6 minutes, a fatal occupational injury occurs every 46 minutes and a work accident that results in an injury occurs every 17 seconds.

In the UK, the 1990 Labor force survey stated that there were an estimated 1.6 million accidents at work where 750000 people suffered ill health caused or made worse by working conditions. In all 30 million working days were lost in which 20000 people were forced to give up work (HSE, 1997).

According to Midcourse Review of Healthy People 2010 (n.d.), barriers to achieving the occupational safety and health objectives include gaps in scientific knowledge, problems in systematic evaluations of interventions, difficulty in establishing the work-relatedness of some medical conditions, lack of public awareness of prevention measures, and the view that certain preventable conditions are an acceptable risk of employment. In addition to this, as the review identifies, workforce and the work place change, new occupational safety and health challenges emerge, such as the increasing participation of older workers in the work force and the changing organization of wok.

Do industrial accidents pose potential threats globally?

Many researches depicted that concern for safety should be of prime importance, that is, nowadays industrial accidents are greater threats globally. This is depicted in the research undertaken in Nigeria (Adebiyi and Owaba, 2009). Accordingly, it is described in the following fashion:

One area in which the concern for safety is growing rapidly is the manufacturing industry. Apart from cost due to down time, overtime work, loss of wages and equipment and hospitalization, the tragedy associated with personal injury, disability and fatality is enormous. In respect of fatalities, industrial accidents take the third place after vehicular accidents and homicide (Watch Tower, 2000). In the USA, it is about 6,500 fatalities per year; 9 million of deaths and disabling injuries (Roland and Morality, 1990). In the UK, 1.6 million of injury accidents and 27 million of non-injury accidents are recorded annually (Phelps, 1999). In Australia, fatalities were 2.6 per 100000 employees while injury rate was 2.7 per 1000 employees in 2002-2003 (NOCSC, 2004). In India, overall injury rate was 1.25 per 1000 workers per year (Mohan et al, 2004); and 37 percent of all reported accidents in Lebanon (Fayad et al, 2003). In the Latin America and Caribbean region, the number is as high as 13.5 per 100000; 34 per 100000 workers in the Republic of Korea and 140 per 1000 of reported accidents in Iran (Roudsari and Ghodsi, 2005). In Finland, 20,016 hospitalization for injuries were recorded between 1990 and 1999 (Mattila et al, 2006); in France 862500 occupational accidents were recorded in year 2000 alone (Fadier and De la Garza, 2006). In Nigeria, the situation may be worse, as inferred in the following report by Nigerian Institute of Safety Professionals (NISP) (2000): “over 11000 people die from on-the-job accidents each year and a worker is injured every 18 seconds in chemical industries in Nigeria”.

Pertaining to occupational risks as depicted by Lind and Nenonend (2008) the most common types of severe and fatal accidents during maintenance operations in industry are crushing and falling. More than one third of accidents are caused by falling and almost every fourth by crushing. Falling is the cause of a relatively greater proportion of fatal accidents than severe ones. In the case of crushing, the proportions are the opposite. Some of the factors for this include working while a machine is in motion and dangerous working practices.

Ethiopian labor law safety and health conditions

The labor law of the Federal Democratic Republic of Ethiopia states that any work provided by the employer shall not make an employee useless. The safety and health condition of employees is decreed in Ethiopian Labor Law. Under the labor proclamation, employers are under obligation to take preventive measures. Likewise, they are obliged to take certain measures to ameliorate the consequences of occupational risks in case they transpire. Occupational injury, as it is envisaged under the proclamation, may arise from either occupational accident or occupational diseases. Therefore, the measures to be taken by employers pertain to both types of employment injuries (Negarit Gazeta, 2004:12).

The Article 92 of the proclamation of Ethiopian Labor Law imposes a number of duties upon employers with regard to taking preventive measures to avert or reduce occupational injuries. Among others, they are required to provide workers with protective equipment, clothing and other materials including appropriate instructions on how to use, and ensure that the work place and premises do not cause danger to health and safety of workers, provided, however, that they are capable of taking such measures.

Approaches to effective safety management

The focus of any systematic approach to safety is the continued diligence of workers, managers and other personnel (Mathis and Jackson, 1997). Accordingly, approaches to effective safety management can be described in three ways. Firstly, the organizational approach which encompasses designs of jobs, development and implementation of safety policies, use of safety committees and coordinating accident investigation. Secondly, engineering approach, the one that encompasses design of work environment, review of equipment and ergonomics. Thirdly, the individual approach which may take in reinforcing safety motivation and attitudes; providing employee safety training; and rewarding safety through incentive programs.

3. Methodology

A descriptive research design was used in the study. A cross-sectional study is best suited to such studies aimed at finding out the prevalence of a phenomenon, situation, problem, attitude or issue, by taking a cross-section of the population. As Kumar (2005) asserts, it is the most appropriate for an investigation of health needs and attitudes of a community towards equity issue and the rest.

In this study, researchers used stratified random sampling technique using occupation as a criterion for stratification. Employees are classified into two strata namely managerial and non-managerial employees. Since members of the managerial staff are relatively very few and the size of non-managerial staff is nearly 450, the variance of these two strata is unequal. Hence, disproportionate stratified random sampling has been taken. Furthermore, for managerial strata, simple random sampling is used and for non-managerial staff systematic sampling has been taken.

As the study comprises of two strata, a reasonable sample size from each strata was taken to fairly represent a large sample. Out of nearly 450 of subordinates 90(20%) of them were selected as a sample size. This is because most employees at different section perform similar activities, hence taking 20% sample can represent the population. Hence out of 90 questionnaires distributed to subordinates for 76 (84.4%), were returned. On the managers side, out of nearly 30 middle and top level officials 15 (50%) of them were taken as a sample representative. Here taking 50% sample respondents from the managers is to have more vivid information pertaining to maintenance and administration of OSH at the company, and then 14(93.3%) questionnaire were returned. Out of the sample respondents taken, an average of 85.71% have responded. Based on these sample responses, detailed analysis and interpretations have been made.

Using Statistical Software Package for Social Sciences (SPSS), some descriptive statistics measures are generated and analyzed. Vital qualitative information obtained from visual observations and informal interview is also used to substantiate the quantitative result.

4. Empirical results

This section gives a descriptive as well as a better understanding with regard to dynamics and processes of what happens in maintaining and practicing occupational safety and health at Bedele Brewery. This analysis, in addition to the information presented in the earlier section, may give new dimensions on the various issues in the following sections.

4.1 Procedures of safety for manual handling

Manual handling of loads and objects is a very common source of workplace injury (Hegney et al., 2004). The study made by Health and Safety Executives (1999) on brewing industry suggests that most accidents caused at brewing industries are due to manual handling especially of Casks, Kegs, Crates and heavy plant. Availability of safety procedures for manual handlings is necessary to reduce such injuries. Based on this stance, the discussion made with key informants indicates that there is a procedure for manual handling in the company.

Table 4.1: Employees awareness about standard procedure for manual handling

Response sets		Employee category: Management Personnel	Non-Management personnel	Total
Yes	Count	4	60	64
	%	36.4%	78.9%	73.6%
No	Count	5	8	13
	%	45.5%	10.5%	14.9%
Indifferent	Count	2	8	10
	%	18.2%	10.5%	11.5%
Total	Count	11	76	87
	%	100.0%	100.0%	100.0%

As the above table depicts, 73.6% of sample respondents responded that they have the knowledge about the existence of procedures for manual handling. This shows that effort on raising awareness of employees on the procedures is available. As per observation made, most employees were not seen fixing the procedures for manual handling on the ground which in turn endangers the maintenance of OSH.

4.2 Provision of safety and occupational health trainings

The objective of the safety-training program is to improve the capability of the foremen and workers alike, for safe performance in all aspects of the job. The discussion held with informants reveals that training has been conducted pertaining to occupational safety and health.

Table 4.2: Provision of companywide safety and health training

			Employee category: Management Personnel	Non-management Personnel	Total
	Yes	Count	7	33	40
		%	53.8%	43.4%	44.9%
	No	Count	3	33	36
		%	23.1%	43.4%	40.4%
	Indifferent	Count	3	10	13
		%	23.1%	13.2%	14.6%
Total		Count	13	76	89
		%	100.0%	100.0%	100.0%

As per the above table, 44.9% of sample respondents responded that the company conducts frequent training pertaining to OSH. In relation to this issue, a cross-check was made whether all employees are provided with the training opportunity. Through the interview made with employees, most of them responded that the company does not provide training pertaining to OSH to whole employees. From the aforementioned facts, one concludes that the company fails to provide OSH training to all employees. Only some parties (individuals) could not maintain occupational safety and health, it should rather be the concern of all employees.

4.3 Safety materials and equipments

According to the Orange County's Safety and Health Program (1997), airborne contaminants in workplaces can be controlled by ventilation equipments. If operation rooms are supplied with ventilation equipments, the possibility of threat caused by combusted air will be minimal. In relation to this concern, the sample respondents were asked whether there are well functioning ventilation equipments around their workplace. The result thereon shows that only 15.7% of the respondents were having operative ventilation equipments in their respective work areas. Based on further observation made, the ventilation equipments were not sufficiently supplied. Even some of the limited supplies were found to be worn-out and not functioning. In implication the company was not giving due considerations pertaining the case in order to maintain safe industrial norms. Furthermore, as it was observed and interview made along with 'safety manager' of the company, the company does not have the required amount and type of fire extinguisher in place in case of fire explosions.

Pertaining to the company's medical care centers for employees' protection both non-managerial employees and managers were asked about the availability of health services for them in the company. In response, more than 92% of non-managerial employees and managers have acknowledged the availability of the service. Yet, most of these employees replied that the clinic delivering the service is not well equipped in terms of health professionals and equipments. Whenever serious injury were occurred, they were obliged to go to the nearby health centers at Bedele and Jimma towns and other private clinics.

The other essential equipment for safety at work is Personal Protective Equipments (PPE). As described in broad range on the Journal of Orange County's Safety and Health Program (2002), PPE is used to safeguard employees from hazards. In consideration to the availability of PPEs in Bedele Brewery, the availability of hard hats has been assessed. The result shows that only 11.2% of the sample respondents were supplied with hard hats for the type of work they do. This means

the company's effort with this regard is quite poor. It has failed to supply its employee's hard hats that could minimize the possibility of threat of falling objects.
As part of provision of safety materials and equipments, the respondents were asked whether protective gloves, shields and/or other equipments have been provided for protecting them from injuries or health hazards caused by sharp, hot or corrosive materials.

The result indicates that the company has provided 85.6% of the sample respondents with protective gloves. In line with their response, most of the employees blame the management for the poor quality of gloves made available and the employees' discomfort was justified by the observation made in the workplace of the employees where it is evident that most of the gloves that the employees were using were worn-out.

According to the Canadian Centre for Occupational Health and Safety (1997) report, hazards exist in every work place; so strategies to protect workers are essential. Against this, the company fails to adequately supply personal protective equipments. In addition to this, those supplied PPE items lack quality. This in turn exposes employees for the threat of potential hazards, which in turn might lead to possibilities of physical injuries. Furthermore, through observation made, the employees were not seen making use of those personal protective equipments, which their company supplied them with. Therefore, the possibility of potential hazard is high. Hence, the company should exert maximum effort in order to alleviate the problem.

The role of stakeholders to minimize the possibilities of potential hazards

In order to maintain and address issues of occupational health and safety in organizations, the role of key stakeholders is essential. The stakeholders are going to vary depending on the issue. As Hegney et al. (2004) suggest, the key stakeholder is the individual employee. In addition to this, the managers at different levels in the company, safety representatives and other interested stakeholders are those who could make a difference. In correlation to this respondents were described the most frequent hazards, the causes of those hazards, and the roles that each stakeholder is expected to play to minimize potential hazards in the company in the following fashion.

The most frequent occupational safety and health hazards

The most frequent occupational safety and health hazards in the company described by most respondents were: accidents encountered by the forklift, the breakage and explosion of bottles that results in physical injury, the threat of fall due to slippery nature of the production centre, slips, trips, falls from height and machineries, musculoskeletal disorders-that is injury (hurt) at the back, arms, and hands, shocks from faulty equipment, and danger of irritation.

Respondents were requested to mention some of the possible reasons for the occurrence of the above safety and health hazards. Lack of ability by most operators, depreciation of machineries, carelessness of employees, reluctance to make use of personal protective equipments (PPE), poor office and operational room layouts, poor maintenance quality, slippery nature of operations rooms, lack of quality safety materials, lack of training pertaining to occupational safety, and health and poor controlling and supervision systems are identified as main causes.

The role of managers to alleviate problems of OSH

Respondents were required to describe the roles that managers are expected to play to reduce workplace hazards. Accordingly they indicated that among other things, the management body of the factory should give an immediate response for the enquiries of employees pertaining to OSH, hire capable personnel, respect subordinates and create team sprit, show commitment for OSH issues and continuous follow up of their subordinates as well as hold regular discussions along with subordinates.

The role of non-managerial employees to alleviate problems of OSH

Most respondents suggested that making use of personal protective equipments (PPE) during operation time, reporting any hazard causing agents on timely basis for respective officials, negligence in the operation sites, keeping their rooms and PPE clean, respecting safety precaution rules, helping anyone who suffers from hazards, avoiding drinks and other drugs during their working times, and cooperating with the management are the main roles that every employee should play to reduce work-related hazards.

The aforementioned results could give a vivid image of the company’s position in maintenance of OSH and give possible clue of the major steps to be taken in order to maintain the well-being of employees.

5. Summary, conclusion and recommendation

Setting safe work procedures are step- by-step measures of doing or carrying out work safely. Though the company sets diversified procedures, there is still a gap in implementing the procedures into practice. A traditional way of handling equipments has still been practiced in the company. In relation to this, providing health and safety training to all employees can promote understanding and knowledge of the key issues in the organization. The company has not provided OSH training to all employees although a few of them have gotten the chance. Such trend may hamper the appropriate maintenance of OSH in the company.

Having procurement standards for goods and equipment can help prevent the introduction of expensive health and safety hazards. Hence, the company has not provided ventilation and fire extinguishers in adequate number and type. In addition to this, though the company provides personal protective equipments (PPE), still there is some gap in their quality. This enhances the possibility of hazards in the company.

Inspections are an invaluable way of identifying potential work place hazards before they cause a healthy and safety problems. Bedele Brewery undergoes inspections of operating materials. The company maintains infrastructures and machineries in a regular basis. This enables the company to monitor in advance the threat of production interruptions.

The company's clinic and first aid supplies were not well furnished. Such conditions may not safeguard sudden ill occurences. That is, action taken in the first minutes is often crucial when saving life and limiting the extent of injury.

Thus, it is recommended that

1. Prevention of occupational disease and reduction in the frequency of accidents in industry has always been a matter of major concern of the organization. Hence the company is supposed to identify areas which are prone to frequent incidents and try to alleviate the problems of OSH in the company with the provision of training. Because safety training can make a difference when it is conducted on a continual basis. Therefore, it is advisable for the company to develop a safety conscious attitude among all members of staff.
2. Selecting the right equipment for the job; making sure that the equipment is safe to use and keeping it safe through regular maintenance greatly helps to minimize the possibility of potential hazards. Therefore, it might be advisable for the company to buy quality Personal Protective Equipments (PPE) for its employees and monitoring its effective use by employees on a continuous basis.
3. When machines, equipments and tools are getting old and outdated, the company's productivity becomes endangered. In additions to this, operating of deteriorated machineries would be a potential source of hazards. Therefore, it is advisable for the company to replace those items with new ones.
4. The poor maintenance of occupational safety and health can have an adverse impact on the company's good will. This in turn may lead to reduction in sales, which at the end endangers the survival of the company. It is, therefore,

advisable for the company's stakeholders to exert efforts to maintain a reliable OSH.

5. In order to induce the smooth running of the company, the arrangement of office and the layout of machineries, is of significant importance. Hence, it is advisable for the company to re-engineer the system.

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HOUSEHOLDS' WILLINGNESS TO PAY FOR IMPROVED SOLID WASTE MANAGEMENT: THE CASE OF MEKELLE CITY, ETHIOPIA

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Abstract

Collecting, transporting and disposing of municipal solid wastes presents formidable challenges to many Third World cities including serious cost recovery problems. The aim of this paper is to estimate the households' willingness to pay (WTP) for improved solid waste management (SWM) in Mekelle city, Ethiopia. Contingent valuation method (CVM) is used as a method of valuation. In addition, probit and tobit models were used in the empirical analysis to determine the factors that influence the WTP and the maximum WTP of households for improved SWM. The results reveal that WTP of households for improved solid waste management are significantly related to income, awareness of environmental quality and age of the household head. Besides, results also reveal that their maximum WTP is proportional to the amount of solid waste generated and type of solid waste service demanded by the household, among others. The current payment for sanitation in the city is far below the WTP of the residents and the mean WTP found in this study can be used by policy makers for decision making in determining the service fee for the improved solid waste management.

Keywords: municipal solid waste management; non-market valuation; willingness to pay, Mekelle city, Ethiopia

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1. Introduction

Due to lack of appropriate planning, inadequate governance, resource constraint and ineffective management solid waste is a major source of concern in many rapidly growing cities in developing countries. According to UNEP (2004), solid waste generation has become an increasing environmental and public health problem everywhere in the world, particularly in developing countries. The fast expansion of urban agricultural and industrial activities stimulated by rapid population growth has produced vast amounts of solid and liquid wastes that pollute the environment and destroy resources. The changing economic trends and rapid urbanization also complicate solid waste management (SWM) in developing countries. Consequently, solid waste is not only increasing in quantity but also changing in composition from less organic to more paper, packing wastes, plastics, glass, metal wastes among others a fact leading to the low collection rates (Bartone & Bernstein, 1993).

In order to cope up with these challenges and due to its crucial role for public health and protecting the environment, accomplishing effective municipal solid waste management should be a priority for emerging cities. However, in the past most attempts to improve solid waste management in cities have focused on the technical aspects of the different means of collection and disposal (World Bank, 1992). It is recently that more attention has been paid to enhancing institutional arrangements for solid waste service delivery, with a special emphasis on privatization.

The involvement of the service recipients or clients especially households that are the primary producers/ generators of a significant proportion of solid waste and perhaps main victims of the effect of uncollected solid waste, should be allowed to determine their outlet or providers and participate in making of sound policy decisions including designing of effective joint solutions of solid waste management. This would help the service providers, i.e., the municipality, to understand households' willingness to participate and pay. Therefore, the key question here is how efficiently and cost effectively can solid waste services be delivered particularly to residential areas?

Urbanization and urban population in Ethiopia have been increasing in the last few years. The rapid growth of population in urban areas due to rural-urban migration and natural high birth rate as well as rising per capita income would presuppose an increased demand in the provision of required infrastructure and public services (Indian Statistical Institute, 2003). However, this has not been the case in Ethiopia, as many towns in Ethiopia lack the financial resources and institutional capacity to provide the most basic infrastructures and services including solid waste management. For example, in Mekelle city, solid waste management service is mainly provided by the municipality. Solid waste management in the city has been always gauged and evaluated based on the role and performance of the service provider, the supply side, while the demand side has been ignored. However, with the increasing volume of solid waste, the Mekelle city administration could not be able to satisfactorily collect and dispose the waste. The coverage of solid waste collection is very low (below 50% most of the time municipality report for 1999 E.C.). If waste is not collected, residents of the city can be exposed to different diseases. "Uncollected waste in developing countries creates serious public health problems in many cities causing many diseases including often fatal water borne diseases such as cholera and dysentery" (Sandhya, 1994). In addition, we observe that the disposal of solid waste in the city is inappropriate and is disposed near farmlands on an open space. Due to the inappropriate disposal, plastic bags taken by wind from the waste disposal site are polluting the farmland of the farmers residing near Mekelle. The problems are likely to become even more pronounced as the level and pace of urbanization continue to grow rapidly. Moreover, cost recovery is a serious problem of solid waste management in the city.

The purpose of this study is to analyze the willingness to pay for improved solid waste management of households in Mekelle city using contingent valuation methods. More specifically, the objectives of this study are twofold: firstly, we examine whether households are willing to pay for improved solid waste management service and determine their mean WTP for improved environmental quality, i.e., improved solid waste management; secondly, we identify the factors that may affect whether or not as well as the amount that households WTP for the improved solid waste management service. Finally, we draw implications for policy and suggest alternative solutions for the existing problems of solid waste management in the city.

The remainder of the paper is organized as follows. In section two, we present a brief review of municipal solid waste management. Section 3 provides the analytical framework and empirical strategy of the study. Section 4 presents study area, survey and data description and section 5 results and discussion. Finally section 6 ends up with conclusions and some policy implications.

2. Municipal solid waste management: Literature review

According to Tchobanglous (1993) all wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted are broadly defined as solid waste. It includes municipal garbage, industrial and commercial wastes, sewerage slug, waste of agricultural and animal husbandry, demolition waste and mining residues. Different individuals have defined municipal solid waste (MSW) differently. Medina (2002) defines MSW as "…the materials discarded in the urban areas for which municipalities are usually held responsible for collection, transport and final disposal. It encompasses household refuse, institutional wastes, street sweepings, commercial wastes, as well as construction and demolition debris. For Cointreau (1982) MSW is material for which the primary generator or user abandoning the material within the urban area requires no compensation after abandonment. Cointreau argues, to be qualified as an urban solid waste it should generally be perceived by society as being within the responsibility of the municipality to collect and dispose of.

Based on the sector of the economy responsible for generating them, Enger and Smith (2006) categorized solid waste into four broader kinds as mining, agricultural, industrial, and municipal solid waste. Municipal solid waste are wastes which are no longer needed by people because they are broken, spoiled, or have no longer any use including waste from households, commercial establishments, institutions, and some industries. Municipal solid waste can further be classified in different ways, with respect to the point of origin of waste material, nature of material, kind of materials and heat contents of the materials. Based on points of origin of the materials there are six types of municipal solid wastes namely: domestic waste, commercial waste, industrial waste, institutional waste, street sweepings and constructions & demolition wastes (Rand et al., 2000). Based on the nature of waste materials MSW can be classified as organic, inorganic, combustible, putrescible and non-putrescible factions (Cornwell, 1998). Cornwell regarded waste classifications based on the kinds and heat content of the waste materials as the most useful. Domestic waste or household waste derived from residential neighborhoods is the largest component of municipal solid waste.

Solid Waste Management (SWM) is defined as the control, generation, storage, collection, transfer and transport, processing and disposal of solid waste consistent with the best practices of public health, economics & financial, engineering, administrative, legal and environmental considerations (Othman, 2002). Solid waste management has three main components: collection and transportation; reuse or recycling; and treatment or disposal (SIDA, 2006). US EPA recommends using integrated, hierarchical approach to waste management with four components: source reduction, recycling, combustion, and land filling, to address the increasing volume of municipal solid waste. It ranks source reduction including reuse as the most preferred method, followed by recycling and composting, and lastly, disposal in combustion facilities and landfills.

Developing countries have peculiar solid waste management problems different from those observed in the industrialized countries;. Low-income countries' solid waste generation rates average only 0.4 to 0.6 kg/person/day as opposed to 0.7 to 1.8

kg/person/day in the industrialized countries, indeed, the very composition of their waste is different from that of 'developed' nations. Cointreau (1982), Blight and Mbande (1996), and Arlosoroff (1982) noted developing countries' wastes are 2-3 times greater in waste density and at the same time 2-3 times greater in moisture content than that of industrialized nations. Developing countries wastes also involve a large amount of organic waste (vegetable matter, etc.), large quantities of dust, dirt (street sweepings, etc), and smaller particle size on average than in industrialized nations.

Although there might be some potential opportunities which arise from their waste composition, these peculiarities from industrialized nations present additional problems (Cointreau, 1982; Zerbock, 2003). Firstly, a higher solid waste density has many implications for the 'traditional' methods of collection and disposal. The collection and transfer trucks which are able to achieve compression rates of up to 4:1 in industrialized nations may achieve only 1.5:1 in developing countries, and landfill compression technology which averages volume reduction of up to 6:1 in industrial nations may only achieve 2:1 compaction with these increased waste densities. Secondly, the high moisture content and organic composition of wastes in the developing world may lead to problems of increased decomposition rates particularly in areas with high average daily temperatures. A high seasonal or year-round rainfall would also compound these problems, presenting additional challenges with insect populations and conditions conducive to disease. In order to mitigate these problems, developing countries in hot, humid areas must do much more frequent collection than would be needed in cooler, drier climates, to remove organic wastes before they are able to decompose. Perhaps a bi-weekly collection of organic material (possibly in conjunction with a municipal composting operation), would be needed to reduce decomposition, if not daily collection.

Collecting, transporting and disposing of MSW presents formidable challenges to many Third World cities. Waste management represents a large expenditure of these cities and usually accounts for 30-50 percent of municipal operational budgets. In addition, despite these high expenses, cities collect only 50-80 percent of the refuse generated (Medina, 2002). Residents in areas that lack refuse collection, usually low-income communities, tend to dump their garbage at the nearest vacant lot, public space, creek, river, or simply burn it in their backyards. Uncollected waste may accumulate on the streets and clog drains when it rains, which may cause flooding. Wastes can also be carried away by runoff water to rivers, lakes and seas, affecting those ecosystems. Alternatively, wastes may end up in open dumps –legal and illegal–, the most common disposal method in the Third World. Open dumping of solid wastes generates various environmental and health hazards. For example, methane and carbon dioxide are greenhouse gases that contribute to global warming. Methane is twenty times more effective at trapping heat than carbon dioxide, and more persistent in the environment (US EPA 1995). Leachate from the landfill can enter ground water systems, leading to increases in nutrient levels that cause eutrophication (El-Fadel et al., 1997). Moreover, bioaccumulation of toxins and heavy metals can occur.

The following conclusions can be drawn from the foregoing review. Firstly, municipal solid waste management is a serious concern, and collecting, transporting and disposing of MSW presents formidable challenges to many Third World cities including Ethiopia. Secondly, waste management represents a large expenditure of these cities and usually accounts for 30-50 percent of municipal operational budgets. Yet, cities collect only 50-80 percent of the refuse generated, despite these high expenses. But, more importantly, cost recovery is a serious impediment to efficient and effective solid waste management in these cities. Thirdly, despite their low average rate of per capita solid waste generation per day, developing countries have peculiar solid waste management problems different from those faced by industrialized countries. In particular, the very composition of their waste is different from that of ‘developed’ nations. These peculiarities from industrialized nations present additional challenges to developing countries’ cities in terms of collection frequencies and equipment demand. Moreover, the relative significance of household socio-economic, waste and environmental attributes of solid waste separation, collection and disposal of households in major developing countries cities have rarely been explored. Therefore, such WTP study would help in finding out sustainable means of funding for improvement of the solid waste management service in the cities.

3. Analytical framework and empirical strategy

3.1 Analytical framework

Much of the concern of empirical environmental economics has been with the economic benefit of changes in the level of environmental quality. That is, environmental and resources economists have been preoccupied with how changes in the provision of environmental public goods impacts upon individual’s utility or welfare and estimating it in monetary terms. In this regard, two most common approaches that have used constitute Marshallian consumer surplus and Hicksian compensated demand. The Marshallian demand approach tracks the 'full price effect' and has been typically used to show how much the quantity consumed of a normal good increases when its price falls. In the case of environmental public goods, however, the individual is usually faced with a quantity rather than a price constraint with the good in question often being un-priced. Furthermore, these goods often have much higher income elasticities than those associated with many ordinary market goods (Bateman et al., 1992), which may undermine the consumer surplus approach of measuring welfare change. Therefore, the Hicksian compensated demand approach is preferred and theoretically more accurate approach of measuring welfare change in this context.

The Hicksian approach evaluates welfare change as the money income adjustment necessary to maintain a constant level of utility before and after the change of provision of the environmental public good. Two such welfare change measures are feasible for such an approach, 'Compensating Variation' (CV) and 'Equivalent Variation' (EV). The CV is the money income adjustment (welfare change) necessary to keep an individual at his initial level of utility (U0) throughout the change of provision, while the EV is the Carson, 1991money income adjustment (welfare change) necessary to maintain an individual at his final level of utility (U1) throughout the provision change (Bateman and Turner, 2000). Similarly the derivatives of these welfare measures are the corresponding demand functions. Depending on the property right assigned, the preferred Hicksian welfare measure can also be expressed in terms of either willingness to pay or willingness to accept compensation (). For a proposed change in provision of the environmental public good which increases utility, the CV measure tells us how much money income the individual should be willing to give up (WTP) to ensure that the change occurs which is appropriate for the issue at hand.

Suppose now an organization is considering an improvement in environmental quality and desires a measure of WTP, i.e., Hicksian compensated surplus where a participant is asked to respond by giving the difference of two expenditure functions:

$$e(p,\ q_o U_o, Q, T) - e(p,\ q_i U_o, Q, T) \qquad (1)$$

where p is vector of prices for the marketed goods, q_i is the environmental quality being changed, U_o is the initial or status quo levels of utility to which the respondent is assumed to be entitled, Q is the vector of other public goods that are assumed not to change, and T is a vector of participant's taste parameters (Deaton and Muellbauer 1980).

Suppose that Y_o is the value of the first expenditure function, i.e., the participant's current income and Y_i is the level of income that solves for U_o given p, q_i Q and T the value of the second expenditure function. Then, we can now define WTP as the difference between Y_o and Y_i. Willig (1976) condition states that equation (1) can equivalently be expressed in an income compensation function form. If WTP is the desired benefit measure, then WTP function is given by:

$$WTP(q_i) = f(p,\ q_o, Q, Y_o, T) \qquad (2)$$

where q_o is now the base line level of the public good of the interest. This equation forms the basis for estimating a valuation function that depicts the monetary value of a change in economic welfare that occurs for any change in q_i (Carson, 1991).

In this study, contingent valuation method (CVM) is used to estimate the benefits from improved solid waste management service. Compared with other valuation techniques, it is considered very flexible and adaptable to some valuation tasks that alternative valuation techniques cannot handle. It is one of the most widely used and generally acceptable techniques for estimating the total economic value of many classes of public goods and services that other economic techniques cannot accommodate. In addition, its results are also relatively easy to understand, interpret, and to use for policy purposes. Despite its advantages and wide range of applicability and can value including the non-use values, CVM has been criticized for many biases: strategic bias, design bias, hypothetical bias, and operational bias (Pearce and Turner, 1990). However, it has to be noted that the limitations are inherent to any valuation method of damages from deprivation of passive-use and not special to the CVM (Arrow el at, 1993). Besides, the limitations (biases) of this method can be eliminated or minimized by appropriately designing of the survey questionnaire according to the guidelines suggested by the NOAA Panel.

3.2 Empirical model specification

The main objectives in WTP survey are to calculate mean WTP and estimating parametric model to allow inclusion of respondents' socio-economic factors into WTP function. Incorporation of individuals' socio-economic variables into the CVM helps the researcher to gain information on validity and reliability of the CVM results and increase confidence in practical application of results obtained from the CVM empirical analysis (Haab and Mc Connell, 2002). Note also that the issue at hand involves yes or no response, on one hand, and elicitation of specific monetary value for the yes responses, on the other hand. Therefore, two models, i.e., probit and tobit models, are used to analyze the WTP of households. Firstly, since we do not know the random part of preferences and can only make probability statements about "yes" or "no", we use the probit model to estimate the probability of WTP. Secondly, since the dependent variable (i.e. WTP) is not fully observed, i.e., is censored at zero, we used tobit model.

The Probit Model

The building block for this model starts with the specification of an indirect utility function for each CVM respondent (Haab and McConnell, 2002). Assume that the representative household gain utility from the improvement in SWM and the two possible levels of environmental quality involved are: the status quo represented by q^0 and a specific level of improvement represented by q^1. Hence, her/ his utility function at status quo (no improvement) will be:

$$u_o = u(y_i, z_i, q^o, \varepsilon_0), \quad (3)$$

and her/his utility function with improvement will be:

$$u_1 = u(y_i, z_i, q^1, \varepsilon_1). \quad (4)$$

We can rewrite equations (3) and (4) into one equation as:

$$u_{ji} = u_j(y_i, z_i, q_i, \varepsilon_j) \quad (5)$$

where j=0,1 refers to the two different states of the environment and i=1,2,…, n refers to individual i and U_{0i} and U_{1i} represent, respectively, indirect utilities at the status quo and the hypothetical improved scenario, y_i is the i^{th} utility maximizer's (individual consumer i) discretionary income, z_i represents a vector of household socio-economic, demographic, environmental and design variables (starting prices, etc), q_i refers to the quality of the good being valued (environmental improvement), and ε_j represents other variables known to the utility maximizer but not observed by the researcher or commonly the error term.

Note that when the quality of good q (environmental quality) changes from $q0$ to $q1$ (as a result of a policy change), the individual's utility also changes from $u(y_i, z_i, q^0, \varepsilon_{0i})$ to $u(y_i, z_i, q^1, \varepsilon_{1i})$. Therefore, the condition that utility maximizer i answers yes to the yes/no CVM question at offered price (bid) bi is given by:

$$u_1(y_i - b_i, z_i, q^1, \varepsilon_{1i}) > u_0(y_i, z_i, q^0, \varepsilon_{0i}) \quad (6)$$

Equation (6) states that household i will answer yes to the yes/no CVM question at offered price (bid) bi if his/her utility at the improved level, net of the required payment, exceeds his/her utility at the status quo. However, because we typically do not know the random part of preferences and can only make probability statements about "yes" or "no", the probability of a utility maximizer answering yes to the valuation question is consequent upon $U_1 > U_0$ (i.e., the utility maximizer is better at

q^1 even with the required payment *bi*). Hence, the probability yes for utility maximizer *i* is given by:

$$Pr(yes) = pr[u_1(y_i – b_i, z_i, q^1, \varepsilon_{1i}) > u_1(y_i, z_i, q^0, \varepsilon_{0i})] \quad (7)$$

Apparently two things turn out important for parametric estimation of the above model. First, we need to choose a functional form for $U(y_i, z_i, q^1, \varepsilon_{1i})$, and secondly, we must also specify the distribution of the error term, ε_{ji} (Haab and McConnell, 2002). Generally, most applied empirical research works be it those employing the Random Willingness to Pay Model (Cameron and James, 1987) or the Utility Differential Model (Hanemann, 1984), begin their specification by assuming a utility function that is additively separable in systematic and stochastic components of preferences as:

$$u_j(y_i, z_i, \varepsilon_{ji}) = v_j(y_i, z_i,) + \varepsilon_{ji} \quad (8)$$

Now, given the specification in (8), then, the probability of utility maximizer *i* giving a positive response to the valuation question becomes:

$$\begin{aligned} Pr(yes) &= pr[v_1(y_i – b_i, z_i, q^1) + \varepsilon_{1i} > v_0(y_i, z_i, q^0) + \varepsilon_{0i}] \quad (9) \\ &= pr[v_1(y_1 - b_i, z_i\, q^1) - v_0(y_i, z_i, q^0) > \varepsilon_{0i} - \varepsilon_{1i} \end{aligned}$$

Note the probability utility maximizer *i* giving a negative response, rejects the improvement, is

$$Pr(no) = 1 - pr(yes) \quad (10)$$

This equation is still too general for parametric estimation. However, when the systematic part of the preference function is assumed linear in income and other covariates, the model can be simplified as:

$$v_{ij}(y_i) = \alpha z_i + \beta(y_i) \quad (11)$$

where y_i represents the individual consumer's (utility maximizer *i*) discretionary income, z_i represents an *m*-vector of household socio-economic, demographic, and environmental and design variables and α_i is an *m* dimensional vector of parameters. For the new SWM CVM scenario, in which the DC question will require a 'yes' or a 'no' response at some offered price *bi*, the probability respondent *i* answering yes to the valuation question is given by:

$$pr(yes) = pr[\alpha z_i + \beta b_i + \varepsilon_i > 0] \quad (12)$$

To estimate equation (12), we assume that the error term is normally, independently and identically distributed with mean zero and variance 1, the result is a probit model.

Let us assume that $\eta = \varepsilon_{0i} - \varepsilon_{1i}$ and let $F_\eta(\ )$ be the cumulative distribution function of η then the probability that the individual is willing to pay for the improvement is:

$$\Pr(\text{yes}) = F_\eta(\Delta v) \qquad (13)$$
$$\Pr(\text{no}) = 1 - F_\eta(\Delta v)$$

where $\Delta V = V_1(y_i - b_i, z_i, q^1) - V_0(y_i, z_i, q^0)$

The main purpose of the analysis is to estimate WTP and from the assumed utility function can drive a WTP function. Assume that P_i is unobservable individual household's actual WTP for improved SWM service, then:

$$p_i = \alpha z_i + \beta(y_i)$$
$$\alpha_0 z_i + \beta(y_i - b_i) + \varepsilon_{0i} = \alpha_1 z_i + \beta(y_i - b_{i,}) + \varepsilon_{1i} \qquad (14)$$
$$= \alpha_1 z_i + \beta(y_i - WTP_{i,}) + \eta_i$$

Where *Pi* is unobservable individual household's actual WTP for improved SWM service

By solving this individual i's WTP can be:

$$WTP_i = \frac{\alpha z_i + \eta_i}{\beta} \qquad (15)$$

In the probit model F_η (..) is the normal cumulative distribution function. As we define above, the unobservable individual household's actual WTP for improved SWM service is P_i with linear relation with the initial bid, b_i and the covariates, then the actual WTP for an individual can be presented as follows:

$$WTP_i = 1 \text{ if } P_i \geq b_i \qquad (16)$$
$$WTP_i = 0 \text{ if } P_i < b_i$$

In a dichotomous choice CVM elicitation format the i^{th} respondent (utility maximizer) is asked if he/she would be willing to pay the initial bid (b_i) to get a given improvement in environmental quality or both quality and quantity in this case solid waste management improvement.

This is a random variable from the viewpoint of the researcher. The probability of yes or no response can be presented as:

$$Pr(\text{yes to } b_i) = Pr(P_i \geq b_i) \quad (17)$$
$$Pr(\text{no to } b_i) = Pr(P_i < b_i)$$

The log likelihood function of this single bounded CV survey response is:

$$\ln L(\theta) = \sum_{i=1}^{N} \{d_i^Y \ln \Pi^Y(b_i) + d_i^n \ln \Pi^\wedge(b_i)\}$$

$$= \sum_{i=1}^{N} \{ d_i^Y \ln G(b_i,\theta) + d_i^N \ln[1-G(b_i,\theta)]\} \quad (18)$$

where $d_i^Y = 1$ if the i^{th} response is yes and 0 otherwise; $d_i^N = 1$ if the i^{th} response is no and 0 otherwise.

$G(b_i, \theta)$ and $1-G(b_i, \theta)$ are the cumulative distribution function (cdf) for the probability of yes and no responses; and θ represents the vector of parameters that index the distribution of WTP.

The Tobit Model

In certain application when the dependent variable is zero for a substantial part of the population, the dependent variable in this case the WTP is not fully observed. The alternative to OLS when dependent variable response is zero for a significant fraction of the observation is the Tobit model (Verbeek, 2000). Generally the standard Tobit model can be summarized as follows (Greene 1994):

$$y_i^* = \beta_{X'_i} + \varepsilon_i, \ i = 1,2, \ldots, N$$
$$y_i = y_i^* \text{ if } y_i^* > 0 \quad (19)$$
$$= 0 \text{ if } y_i^* \leq 0$$

Where ε_i is assumed to be NID $(0, \sigma^2)$ and independent of x_i.

Let MWTP be latent variable which is not observed when it is less than or equal to zero but is observed if it is greater than zero. Following Verbeek (2000) the Tobit model for the observed maximum willingness to pay (MWTP) for this particular study is given by:

$$MWTP_i^* = \alpha + \beta_{X'_i} + \varepsilon_i$$
$$MWTP = MWTP_i^* \text{ if } MWTP_i^* > 0 \quad (20)$$
$$= 0 \text{ if } MWTP_i^* \leq 0$$

where $MWTP_i$ is the unobserved maximum willingness to pay of an individual for improved solid waste management, $MWTP_i^*$ is the actual maximum willingness to pay of an individual for improved solid waste management, $_X$' is vector of independent variables, β is vector of coefficients, α is the intercept, and ε_i is disturbance term, which is assumed to be NID (0, σ^2) and independent of x_i. Assume that Censoring point is zero

$$\begin{aligned} MWTP \; = \; & \alpha+\beta_1 ASWG+\beta_2\, Income +\beta_3\, Bid+\beta_4\, SER +\beta_5\, AGR +\beta_6\, EDLR + \\ & \beta_7\, EAR +\beta_8\, Fam\_Sz +\beta_9\, Marriage +\beta_{10}\, PERCEPT +\beta_{11}\, House \qquad (21) \\ & +\beta_{12}\, TSWSD+ \varepsilon_i \quad if\ MWTP_i^* \; > 0 \\ & = 0\ otherwise\ (if\ MWTP_i^* \; \leq \; 0 \;\;) \end{aligned}$$

Where, *β1-β12* stands for the vector of coefficients, ***ASWG*** stands for the amount of solid waste generated by the respondent (household), ***Income*** is income of the respondent*,* ***Bid*** is starting bid, ***SER*** stands for sex of the respondent*,* ***AGR*** is age of the respondent, ***EDLR*** *is* educational level of respondent*,* ***EAR*** is environmental awareness of the respondent, ***Fam_Sz*** is family size of the household*,* ***Marriage,*** is marital status of the respondent, ***PERCEPT*** is perception of the respondent on the existing system of solid waste management of the city*,* ***house*** is house ownership of the respondent ***TSWSD*** is type of solid waste service demanded by the respondent.

4. Study area, survey and data description

4.1 The study area

Mekelle is the capital city of Tigrai National Regional State found about 800km away north of Addis Ababa. It was established during Emperor Yohannes IV in 1880 and its municipality was established in the early 1940s. It is located between $13^0 32$ North Latitude and $39^0 28$ East Longitude. The city enjoys an average annual temperature of about 25^0c and an altitude range of 2150 to 2270 meters above sea level. The average annual rainfall is about 579 mm. The size of the city covers around 100 square kilometers. The current population of the city is about 257, 290 with an annual growth rate of 5.4 percent[4] and an average family size of 5 persons.

Municipal solid waste generation of the city in terms of weight is estimated about 0.3 kilogram per capita per day (Teklay, 2004). Solid waste generation in the city appears very low compared to other low-income countries such as Nepal, Bangladesh and Cambodia which is 0.5-1.00 kg/capita/day (Zurbrügg, 2002). Nonetheless, it could be envisaged how much solid waste is generated in the city annually given the

[4] strategic plan of Mekelle city for 1996-1998 E.C

population size. The municipality plays a predominant role in the solid waste collection. Currently, the municipality collects the solid waste by using 14 waste picker cooperatives known as MSEs (Micro and Small Enterprises) of which, 11 cooperatives are engaged in door to door collection, 2 cooperatives in street sweeping (only asphalt), and 1 cooperative in collection from open space and near the communal containers. The waste picker cooperatives bring the waste to the communal containers located near the area. The municipality pays for the cooperatives Birr 33.30 per meter cube they collect.

The operational modes of primary collection in the city includes hand carts system by the MSEs and private firm, horse cart system by private firm, manual adult labour (own force and hired), manual child labor by households, street sweepers wheel barrow system. There are 64 communal containers distributed all over the city, 1 container per 54 hectare on average. The of municipality transports the collected solid waste from the communal containers to the landfill site using 3 skip loaders with a capacity of 8 m^3 each. However, there are many problems related to collection and disposal of solid waste in the city. Firstly, collection coverage is too low and less that 50 percent of the solid waste has currently been collected. Secondly, cost recovery is a serious problem of solid waste management. For example, during the first half of 2007/08 fiscal year only Birr 90, 283.00 of sanitary revenue was generated while the corresponding sanitary expenditure for this same 6 month period was Birr 953 421.81. The revenue generated covers only 9.5 percent and the rest 90.5 percent has to be covered from other sources. This revenue problem has resulted in meager supply of waste containers and the longer distance to those containers can increase the probability of waste dumping in open and roadsides relative to the use of communal containers located in distant areas" (Tadesse , Ruijs , and Hagos , 2008). Therefore, to improve the solid waste management service, the city needs to find sustainable means of funding. One way of financing the service is community involvement in the financing to the service improvement and therefore estimation of households' WTP turns out to be important.

The city's annual solid waste generation is 28098577 kilogram. Collection coverage of solid waste based on the study by Promise Consultant (2005) was only 34.2 percent. Solid waste collection coverage is very low; this implies solid waste is thrown everywhere in the city such as open space, green areas, rivers, canal ditches etc; due to this, waste is spread to all residential houses in the form of dust by the high wind in the city and causes disease. Canal ditches and sewerage system filled by waste and causes flood overtop on the streets. In addition, none of the modern solid waste management is implemented and still there are no recycling activities by the municipality in an organized manner. Solid waste is not separated or sorted at source and after collection simply it is dumped together. But, more importantly, cost recovery a serious problem of solid waste management in the city. The revenue generated covers only 9.5 percent and the rest 90.5 percent has to be covered from other sources. Since the waste management does not have enough source of revenue it can't be sustainable even with the present condition.

4.2 Sampling, design of survey questionnaire and elicitation format

Sample households for the study are drawn from six[5] local administrations in the city. The list of household heads in the respective local administrations was used as a sampling frame from households that resided one year and above in the area. Proportionate random sampling is applied and based on this, 240 household heads are drawn proportionally from the local administrations except Quiha, and 226 questionnaires are completed.

The survey instrument was designed and structured based on the recommendations of NOAA panel and Carson el at (2000). Carson et al. suggest a CVM survey questionnaire should include: (1) an introductory section which helps set the general context for the decision to be made; (2) a detailed description of the good to be offered to the respondent; (3) the institutional setting in which the good will be provided; (4) the manner in which the good will be paid for; (5) a method by which the survey elicits the respondent's preferences with respect to the good; (6) debriefing questions about why respondents answered certain questions the way that they did; and (7) the collection of a set of respondent characteristics including attitudes, debriefing questions, and demographic information.

In our case, it consisted of four sections. Section I, questions related to respondents awareness and current situation of solid waste in the city; section II, questions related to the environmental problem and description of scenario (i.e. the proposed SWM improvement scheme), section III, questions related to WTP and section IV, questions related to socio-economic conditions of the households. The scenarios described in the survey explain in detail about the services to be provided in terms of its uses and reliability, the current condition of waste management problems in the city, the hypothetical improved condition and the way in which each consumer would pay for the improvement (payment vehicle).

We employed CVM, with a single bounded dichotomous choice elicitation format followed by open-ended questions in the WTP section for its advantages. The survey was conducted during the period of March - May 2008. First, the questionnaire is translated in to the local language, 'Tigrigna,' for better understanding of the

[5] Kedamay Woyane, Adi Haki, Hadnet, Hawelti, Semen, and Ayder Local adminstrations

respondents and enumerators. Six data collectors (one from each local administration), all of whom have college diploma and above, were employed based on the experience they have on data collection and their educational level. One-day training was given to the enumerators to well understand each question and on how they should interview and approach the respondents to get valid information. Emphasis was also given to consent of respondents on the training session. Pilot survey on 12 household heads was conducted before the actual survey. The purpose of this pilot survey was to determine the initial bid and to have better understanding of how the actual survey should be conducted.

4.3 Data description

Data obtained covered socio-economic and demographic characteristics of households including gender and age of head, marital status, family size, income, and house ownership; environmental attributes such as their level of environmental awareness, amount of solid waste generated by the household, etc; and design variables such as starting prices, etc and maximum WTP in relation to the quality of the good being valued (environmental improvement).

Table 1 provides definition and measurement of the variables whereas Table 2 reports description of variables used in the analysis including means and standard deviation. As could be clear from Table 3 four starting bid prices were used in the study. These starting bids are determined based on the pilot survey and assessment of the current practice in the city. Only 24 individuals, i.e., 10.6 percent of all the respondents said no for the initial bid. The frequency of no response for WTP increases with an increase in the initial bids. The mean of the starting bids is Birr 7.25 per month.

Table 4 provides WTP responses in relation to the socio-economic characteristic of the sample households. About 92 percent had positive WTP values for the improvement in SWM. Considering the entire sample, 51.3 percent are females[6] while the rest are males. Greater proportion of female respondents, (95.7 percent) had positive WTP for improved SWM as compared to male respondents had, 88.2 percent. It might be due to the reason that traditionally females are more responsible for solid waste management. The average monthly income of sample households was found to be Birr 1495.85 with a minimum monthly income of Birr 200.00 and a maximum of Birr 12776.00.

[6] Not all of the females are heads of households, some of them are wives and others are elders interviewed when the head of the household was not found during the interview.

The percentage of yes response for the improved SWM system increases with the level of income and education. The average age of respondents is 39.5 years and average family size is 4.76. In addition, 53.54 percent of them currently live in their own houses and the rest of them live in rented houses, either from public or private owners.

Table 4: WTP responses and socio-economic characteristics of sample households

Socio-economic condition of households		WTP for improved environment (solid waste management)		
		Yes	No	Percentage of yes response
Gender	Male	97	13	88.18
	Female	111	5	95.69
Age of respondent in years	20-40	122	-	100
	41-60	81	15	84.38
	Above 60	5	3	62.50
Educational level	Illiterate	20	11	64.52
	Elementary	55	6	90.16
	Secondary	68	1	98.55
	Tertiary	65	-	100.00
Income	< 600 Birr	34	11	75.56
	600-1200	75	5	93.75
	1201-2000	42	2	95.45
	Above 2000	57	-	100.00
Family size	≤ 2	31	-	100.00
	3- 6	145	15	90.63
	> 6	32	3	91.43
Marital status	Married	154	9	94.49
	Single	25	1	96.15
	Widow/widower	7	6	53. 85
	Divorced	22	2	91.67
Employment	Civil servant and company employed	77	2	97.47
	Traders	84	5	94.38
	Self employed and daily laborers	24	3	88.89
	Unemployed	12	4	75.00
	Others*	11	4	73.33

Source: survey of this study

* Others include retired and board

Regarding environmental attributes, 53.3 percent sample households consider the current SWM as not good and 48.8 percent perceived the current SWM system as fair. Furthermore, 58.4 percent demanded only collection and disposal services of solid waste management while 41.6 percent demanded recycling in addition to collection and disposal. On average sample households generate 0.44 sacks of solid waste per week, with the minimum and maximum being 0.25 and 2 sacks per week, respectively. Respondents were asked as to where they dispose their solid wastes and around 40 percent reported that they dispose their solid wastes on the nearby container, about 12 percent and 2.6 percent dispose on an open space and around the riversides near their home respectively. Only for 45.6 percent of the respondents had their wastes collected from home by the waste picker cooperatives employed by the municipality on contract basis. Almost all respondents reported that they dispose their solid waste altogether be it organic, plastic or galas with no waste separation at the source. In addition 90.26 percent agreed that women are responsible for collection and disposal of solid waste in the household, 5.6 percent give responsibility to children and the remaining 4 percent responded that both women and children are responsible.

Respondents were also interviewed about whose responsibility SWM is at the city level; around 44 percent responded that it is the responsibility of the municipality or city government, about 28.3 percent responded that it is community's and 27.8 percent said all government, community and polluters are responsible. On the question of who should provide the improved solid waste management service, 34 percent preferred the service to be provided by the government, 24 percent by private enterprises and 42 percent by organized communities.

5. Empirical result and discussion

5.1 Empirical review of previous studies

Contingent valuation method (CVM) was proposed and first used in developed countries for valuation of public goods like access to parks, clean air or water, endangered species or unobstructed views. Nowadays, CVM in developing countries has been used most often for valuation of publicly or privately provided goods, such as water supply and sewerage in areas without existing services. In these cases CVM has been used as a type of market analysis, to guide systems design and setting of tariff rates (Pearce and Turner, 1990).

In this part, solid waste management studies in Ethiopia particularly those of used Contingent Valuation Method have been reviewed. In Ethiopia, particularly in Addis Ababa, CVM and Choice Model based studies have been made on improvement of solid waste management services, improved water and sanitation services and other improvements in environmental amenities in the last few years.

Yitbarek (1998) in (Solomon, 2007) had undertaken a CV survey on solid waste collection in Addis Ababa. He employed a face-to-face interview method and used an open ended questionnaire to elicit respondents WTP using 210 sample households selected randomly. In his paper, linear and log-linear models (OLS) were used to analyze the significance of the independent variables: respondents' interest in environmental problems, awareness of solid waste problems, perceived level of existing solid waste collection system, responsibility of various solid waste problems, age, sex, family size, level of education, and household income of which awareness of solid waste management problem, household income and interest in environmental problems were found significant that determine respondents' WTP values.

Aklilu (2002) used CVM based on a closed ended with a follow-up elicitation format to estimate WTP for improved SWM of households of Addis Ababa, by using 430 sample households selected at random. He employed TOBIT model for the analysis and results showed that income of households, time spent in the area, quantity of waste generated.

5.2 Empirical results of WTP analysis

We now turn to the multivariate empirical analysis results that can give us a broader framework as to which factors are responsible for the Willingness to Pay (WTP) for improved solid waste management service as well as the amount of money that households are willing to pay.

First, it is necessary to distinguish between responses that can be considered as valid and those that appear 'invalid'[7]. Out of the 226 completed interviews, 24 respondents (10.6 percent) were considered to have invalid responses to the valuation question. The main reasons for such invalid responses include actual zeros (6) or protest zeros (12) and outliers (4). Identification of actual or protest zeros was based on a follow-up question to the valuation question in which the respondent was asked to give reasons for not wanting to pay for the scheme. Six said they have insufficient income to pay, two said that they have no faith on the scheme, whereas ten said they would prefer to wait for the city government. Outliers are those whose maximum willingness-to-pay bids are more than 5% of their estimated income no in this case, and also those who accepted the improvement but reported a significantly

[7] By 'invalid', we mean WTP responses that were actually excluded from the censored regression (i.e., actual or protest zeros, as well as outliers).

lower amount than the initial start price (bid) in the follow-up question in this case (four).

In addition, it was also necessary to determine whether excluding invalid responses from the econometric analysis would lead to a sample selection bias. Simple comparisons of means of household covariates between the two groups (i.e., valid and invalid responses) were performed. For some of the variables such as the gender of the respondent, income, perception of existing SWM system, educational level and household generation of wastes, the differences between the two groups (i.e., valid and invalid responses) are quite significant. If these variables influence the respondent's WTP value for the scheme, then the final estimates obtained from the sub-sample of valid responses may be affected by selectivity bias and therefore we include all the respondents in the analysis.

Second, checking for various econometric issues is very important. In order to test whether multicolinearity is present or not a simple correlation coefficient matrix has been computed. Gujarati (1995) sets a rule of thumb, which indicates that multicolinearity is a serious problem when correlation coefficient is 0.8 and above. The expenditure of the respondent is omitted due to high correlation with income. Generally, multicolinearity is not a serious problem in this data. In addition, we are likely to encounter hetroskedasticity, particularly with the cross-section data. The reason is that the dependent variable is expected to vary as explanatory variables change and this is the very reason of their functional relationship. Instead, the variability of the error term seldom remains constant when the levels of one or more explanatory variables increase or decrease. Therefore, there is a need to test on the possible existence of this problem and the test conducted.

The results of the probit model in Table 5 indicated that some variables are significant whereas the majority are tuned out to be insignificant. The variables that are significantly related to providing positive WTP values are household income, level of awareness of environmental quality and age. While household income and level of awareness of environmental quality tuned out positive, age has negatively related with WTP. All of the signs of these three variable coefficients make intuitive sense. A higher income consumer apparently has a greater demand for the waste-management amenity and is, therefore, more willing to pay for it. Households with higher awareness of environmental quality also tend to provide positive WTP values. On the other hand, age of households head has negative relationship with WTP. It suggests that the old people who perhaps freely disposed their solid waste for many years are less willing to pay for improved solid waste management.

Table 1: Probit model estimation results of determinants of WTP

Variable	Coefficient	z-statistic
Age of head	-0.064**	-2.39
Sex of head	0.428	0.96
Education	0.108	0.29
Awareness	1.581***	2.54
Family size	-0.026	-0.21
Income	0.004***	6.98
Marriage	0.556	1.07
Perception	0.457	0.82
House ownership	0.618	1.12
Household waste	0.039	0.03
Type of solid waste service	0.025	0.04
Starting price	-1.972	-1.30

We also tested for goodness of fit measure, which is a summary statistic including the accuracy with which the model approximates the observed data. Some of the measures of goodness of fit are PseudoR^2 and McFadden. The results of test for goodness of fit are: PseudoR^2 = 0.6398 and McFadden= 0.608461. As the value of the calculated result closes to 1, the explanatory power of the model will increase.

In the case of Tobit model results, s indicated in Table 6, eight out of the twelve explanatory variables turned out statistically significant. Amount of solid waste generated by the household per week: this variable has a positive impact on the amount of WTP as expected and it is statistically significant even at 1% i.e. households that generate more solid waste will have more demand for improved SWM system.

Table 2: Tobit model results of determinants of the amount of WTP

Variable	Coefficient	t-statistic
Age of head	-0.035	-1.32
Sex of head	-0.168	-0.38
Education	1.120***	3.96
Awareness	2.287***	5.02
Family size	-0.106	-0.83
Income	0.001***	3.21
Marriage	0.905*	1.74
Perception	-1.239***	-2.47
House ownership	1.310***	2.82
Household waste	4.795***	5.18
Type of solid waste service	1.217**	2.38
Starting price	-0.751	-0.48

Type of solid waste service demanded by the households: As explained earlier this is a dummy variable and takes 1 if respondents choose collection, recycling and separation of waste and zero otherwise. This dummy shows a positive relation with the amount of WTP and is significant at 5 percent significant level. This can be related with the awareness of respondents and as respondents are more aware about the environment, they prefer for best method of solid waste management i.e. separation and recycling in addition to collection and disposal, and households that prefer for separation and recycling may have greater amount of WTP for improved SWM than the others.

Educational level of respondents: educational level of respondents has a strong positive relationship with amount of WTP and it is significant at 1%. It is logical that as respondents' educational level increases, their income increases; this leads to increase in environmental demand.

Environmental awareness of respondents: this variable has a positive relationship and is significant at 1 percent. More awareness about the environment means respondents know the benefit of the environment and it is likely to have more environmental demand.

Income of respondents (income): is another determinant that has a positive impact on the amount of WTP. It is significant at 1 percent level. This is consistent with economic theory that explains income is positively related with demand in general and the same with environmental demand. This also indicates that environmental good is a normal good since its demand increases with income.

Perception of respondents for the current solid waste management was found to have a negative impact on WTP for improved solid waste management and significant at 5%. The negative relationship indicates that households that perceive the current SWM system as good will be less willing to pay than households that perceive the current solid waste management system as bad.

Marital status has a positive and significant at 10% significant level with amount of WTP. It appears married households are more responsible and have higher WTP than the unmarried ones.

House ownership has a significant impact at 1 percent and a positive relation with WTP which means households that live in their own house have more WTP for improved SWM system than those living in rented houses. This may be because of those people living in a rented house considering their residential area as temporary or may be due to the current condition in the city that only house owners are paying for sanitation.

The other four variables such as starting bid, sex of respondents, family size of the household, and age of the respondent have no significant impact on the amount of WTP for improved solid waste management.

Generally, in the Probit model, the variables which have individual insignificant influence to WTP may have significant impact together in addition to the three variables. Unlike the Probit model many variables in the Tobit model have prior expected sign and significant relation with the amount of WTP for improved solid waste management service.

5.3 Estimation of benefits for improved solid waste management

So far we have seen the factors that are influential for WTP when there is improvement in solid waste management service. Now we look to the aggregation and estimation of benefits due to improved SWM system which is the last part of CVM survey.

One of the main objectives of estimating empirical WTP model on basis of the CVM survey response is to draw central measure or mean and median of the WTP distribution (Hanemann, 1994). The mean WTP is –intercept divided by the bid coefficient.

The mean WTP (μ) using probit model for the single bounded dichotomous format is calculated as:

$$\mu = -\alpha/\beta \quad \text{where } \alpha \text{ is the intercept and } \beta \text{ is coefficient of the bid}$$

Therefore the monthly mean WTP of the respondents (sample household heads) can be computed by using the above formula and from the results from the single bounded model. Using Limdep version 7, the mean WTP for improved solid waste management per month per household is found to be Ethiopian Birr 8.68

In addition, we can also compute the mean WTP using the open-ended elicitation format i.e. the maximum WTP of the respondents. As could be clear from Table 2, mean WTP from the open-ended format is Birr 7.88 per month per household which is less than but closer to the closed format. Therefore, households' mean WTP for improved solid waste management is to be Birr 7.88 per month per household.

Hence, we can calculate the monthly WTP for the city by multiplying this mean by the total number of households and it is about Birr 426,229.20 per month.

Furthermore, we can also estimate by using one of the aggregation methods of WTP. As explained earlier, the current population of Mekelle is 257,290 and given the sample average family size is 4.76 the number of households will be is about 54090.

Table 3: Total monthly WTP estimates for improved SWM in residential houses of Mekelle city

WTP interval (Birr per month)	Frequency of sample distribution		Mid WTP	Total Number of households	Total WTP
	Number	Percent			
0 - 3	36	0.159292	2	8616.106195	17232.21
4 -6	83	0.367257	5	19864.9115	99324.56
7 -9	19	0.084071	8	4547.389381	36379.12
10 – 12	59	0.261062	11	14120.84071	155329.2
13 – 15	12	0.053097	14	2872.035398	40208.5
16 – 18	2	0.00885	17	478.6725664	8137.434
19 - 21	14	0.061947	20	3350.707965	67014.16
22 – 24	0	0	23	0	0
25 -27	0	0	26	0	0
28 -30	1	0.004425	29	239.3362832	6940.752
Total	226	1		54090	430566

Source: result of this study

Prior to the aggregation of benefits, class boundaries for the results of the open-ended questions are set. The mid WTP or class mark is the average of the WTP interval or class boundaries. The total monthly WTP of the city using this method is estimated to be Birr 430566.00. Using the dichotomous single bounded question the monthly WTP is estimated to be Birr 469501.20 and therefore the actual WTP of the households in Mekelle city may fall between these two figures.

6. Conclusions and policy implications

6.1 Conclusions

In several rapidly growing cities in developing countries solid waste is a major source of concern due to lack of appropriate planning, inadequate governance, resource constraint and ineffective solid waste management. According to UNEP (2004), the generation of solid waste has become an increasing environmental and public health problem everywhere in the world, particularly in developing countries.

In Mekelle city, solid waste management is mainly provided by the municipality and it has been measured and evaluated always based on the role and performance of the service provider (supplier of the service) and demand side i.e. WTP of the residents is ignored. The participation of the service receivers or clients especially households that are the primary producers and generators of significant proportion of uncollected solid waste and perhaps the main victims of the effect of solid waste, should allow to determine their providers and participate in making of sound policy decisions including designing of effective joint solutions of solid management. Among others, this would help the providers to understand households' willingness to participate and pay.

The study aimed to analyze households' valuation of improved solid waste management service in Mekelle city by using the data obtained from the sample of 226 household heads. The study used primary data from the sample and secondary data from respective institutes, authorities and reference materials.

CVM method was employed with single bounded elicitation format followed by open-ended follow-up questions, and we administered the survey using face to face interview (in person interview). The study used both descriptive and econometric techniques of analysis and twelve explanatory variables were used in the regression models based on the degree of theoretical importance and their impact on WTP. Probit and Tobit models were used to identify the determinants of households' WTP for improved solid waste management system and to analyze the mean WTP of households.

From the probit model estimation, the variables that have statistically significant relationship with WTP are household income, and respondents' awareness of environmental quality and age, the coefficients of the first two being positive whereas the third one is negative. The rest of the variables have no significant impact on the likelihood that the respondents will provide a positive WTP value.

In the tobit model regression results, on the other hand, eight out of twelve explanatory variables have statistically significant impact on the amount of WTP for improved solid waste management system. Amount of solid waste generated by the household per week, educational level of respondents, environmental awareness of respondents and house ownership of household heads have a positive relationship with the amount of WTP and significant even at 1 percent. Type of solid waste service demanded by the households and Income of respondents (income) have positive relationship and significant at 5% and marriage of respondents (marriage) has positive and significant at 10 % significant level while perception of respondents for the current solid waste management (PERCEPT) has negative relation and significant at 5% with the amount of WTP for improved solid waste management system.

By using Single bounded elicitation format, the mean WTP for improved solid waste management per month per household is found to be Ethiopian Birr 8.68 and using the open-ended (maximum WTP) is found to be Birr 7.88 per month per household. The total monthly WTP of the city using aggregation method is estimated to be Birr 430566.00. Using the dichotomous single bounded question the monthly WTP is estimated to be Birr 469501.20 and, therefore, the actual WTP of the households in Mekelle city may fall between these two figures. Comparing with the revenue collected based on the service fee regulation and current expenditure for the existing solid waste management, this WTP is much bigger and SWM of the city can be improved by residents' participation.

6.2 Policy implications

- By the current sanitation fee and the existing system, the solid waste management cannot be improved and can't cover its cost even with the existing level and; therefore, participation of residents is important to have an improved solid waste management in the city on a sustainable basis.
- Assuming that what respondents' say today remained the same for the future, an important policy implication of greater WTP obtained in this study is that the current payment for sanitation in the city is much below WTP of the people.
- The strong positive relationship between income, environmental awareness of respondents and educational level reveals that efforts towards improving residents' income, environmental awareness, and education will increase WTP for improved environmental quality in general and improved solid waste management in particular.
- If people know or are informed about the nature of improvement in environmental quality, that is, improved solid waste management, the envisaged welfare improvement elicits people's WTP (Hartwick et al 1998). Therefore WTP can be used to predict the level of welfare gained from improved SWM system.
- Given that the mean WTP is closed to the actual service charge of private solid waste collectors (Birr 10) the study can be used as a base for sanitation fee to be charged to the various waste-generating agents such as households for public decision making.
- By charging the mean WTP of this study to each household, efficient and better solid waste management service can be provided in the city.

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Annexes

Table 4: Definition and measurement of variables used in the analysis

Variable definition	Description
Willingness to Pay (WTP) (dep. var. in Probit Analysis)	1 if WTP>0 and 0 otherwise (i.e. 1 for a yes answer to the offered starting bid and 0 otherwise)
Maximum WTP	Monthly Maximum WTP in Birr of the respondent
Starting bid (bi)	The initial bids offered to the respondents DC question in Birr monthly 2.50, 5.00, 10.00, 15.00
Age (AGR)	Age of respondent in year
Sex (SER)	Gender of respondent coded as 1 if respondent is female and 0 otherwise
Perception	Perception of the respondent on the current solid waste management =1 if respondent perceives current solid waste management as fair and 0 otherwise
Household waste (ASWG)	Household's weekly generation of solid waste measured in sacks
Educational level (EDLR)	Educational level of respondents represented as 0 for illiterate and informal education 1 for elementary 2 for secondary and 3 for tertiary
Family size (Fam_Sz)	Number of members of the household
Marriage	Marital status of the respondent, 1 for married and 0 otherwise
Income	Monthly income of the head of the household in Birr
Awareness (EAR)	Environmental awareness of the respondent, 0 for not aware, 1 for fairly aware and 2 for much aware
House ownership	House ownership of the respondent, 1 if owns the house and 0 otherwise
Type of solid waste service (TSWSD)	Type of solid waste service demanded by the household, 1 for collection, recycling and disposal and 0 otherwise

Table 5: Description statistics of variables used in the analysis

Variables	Mean	Standard deviation	Min	Max
WTP (dep. var. in Probit Analysis)	.920354	.271345	0	1
Maximum WTP	7.878319	5.21255	0	30
Starting bid (bi)	7.47549	4.161797	2.50	15.00
Age (AGR)	39.5354	10.8538	20	70
Sex (SER)	.5132743	.5009332	0	1
Perception	.4867257	.500933	0	1
Household waste	0.436946	0.25420	.25	2
Education (EDLR)	1.743363	1.02223	0	3
Fam_Sz	4.756637	1.94777	1	11
Marriage	.7212389	.449385	0	1
Income	1495.854	1325.04	200	12776
Awareness (EAR)	1.287611	.680866	0	2
House ownership	.5353982	.499852	0	1
Type of solid waste service (TSWSD)	1.41592	.493975	1	2

Source: result of this survey

Table 6: WTP response against starting bids

Response to initial Bids	Initial Bids			
	2.50	**5.00**	**10.00**	**15.00**
Yes	16	99	64	23
No	24	40	139	203
Percentage of no response	10.62	17.70	61.50	89.82

DOMESTIC WATER DEMAND IN ETHIOPIA: THE CASE OF MEKELLE CITY

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Abstract

Water is an essential nutrient for all known forms of life. But the actual situation shows that especially in most developing countries, the provision of water is at a low level. Perhaps recognizing the harmful consequences to health, economic productivity and overall quality of life of its inadequate supply, most institutions that have aim to address this problem seem to be concerned on the supply side while neglecting the demand side. Nonetheless, the latter has also significant policy implications in terms of demand management. This study tries to asses the main determinants of water demand based on the existing situation of the service and household characteristics to draw policy implications that would enable to narrow the existing gap between demand and supply.

The study used survey responses of 150 random sampled households from three local administrations of Mekelle city. Both descriptive and econometric analyses are used to analyze the data. Result shows that 100% of the survey respondents use piped water source. Income, type of occupation, education level and family size positively influence the demand for water whereas time loss to collect water from other sources, when their own water source is not available, affects consumption negatively. Findings imply the need to improve water supply service in light of the income growth and improvements in education level of citizens. It is also implied that policy on population might have an important role to narrow the gap between demand and supply of water.

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1. Introduction

Economic infrastructure has a substantial impact on economic development and human welfare of every nation. It is believed to be essential for modernization and diversify production. It also helps countries compete internationally and accommodate rapid urbanization. In the attempt to raise productivity and improve living standards, developing countries have been making a substantial amount of investment in new infrastructure, such as transport, water and sanitation, power supply, telecommunication and irrigation (Fissha, 2006).

The provision of adequate supply of potable water is essential for life both in developing and developed countries (Bayrau, 2004) and it should be financially and physically accessible to all consumers (Cleophas, 1996). The fact, however, is that more than 1.2 billion people worldwide and one in every four people in the developing world currently lack access to safe water supply. Two in every five people also have no access to improved sanitation and approximately 450 million people in more than 30 countries face serious shortage of fresh water. By 2025 this number is expected to increase to 2.8 billion people in more than 48 countries, 40 of which will be either the Middle East, Northern Africa or in Sub-Saharan Africa (US AID, 2007). The problem is more severe in rural parts of the developing countries, because water is an expensive commodity and only 30%, 50% and 70% of the rural population worldwide had access to safe water supply in 1980, 1990 and 1994 respectively. In spite of the significant improvement made to facilitate access to safe water in rural areas, services provided in many countries are still not up to the standard (Zekri, and Dinar, 2003).

Water supply service in Ethiopia is currently also found below the required level. The average access to safe water supply is 28% of the total population of the country [G.Egziabher, 2007]. The average per capita consumption in urban areas is close to 15 liters per day. This can be taken as an example of both a very low level and coverage of supply, even by Sub-Saharan Africa standards. It must be noted here that the coverage figure will even reflect a much worse situation considering the unreliability and un-sustainability of the supply of safe water in the major cities of the country. This is a clear indication of the vulnerability of the wellbeing and productivity of the Ethiopia people.

The aim of this study is, therefore, to identify determinants of demand for water consumption so as to propose policy implications that address the mismatch between the rapidly growing demand and limited supply of water.

More specifically the study seeks to address the following questions.

- Does income have any significant effect on demand for water?
- How does education affect for (consumption of) safe water?
- Could population policy have any crucial importance to narrow the gap between demand for and supply of water?

The remaining part of the paper is organized as follows. In the next section, we provide a short description about the study area. Section 3 reviews some literature on the area. Section 4 and Section 5 deal with methodology and presentation of results and discussion. In Section 6, conclusions and recommendations are provided.

2. Description of the study area

2.1 Location

Mekelle is the capital city of Tigrai regional state and the center of the region's economic activities. The city is one of the Ethiopian ancient towns. Geographically, it is located in the northern highland of Ethiopia, some 783 km far from Addis Ababa. Lying between 39'28 East and 13'28 North latitude, Mekelle is found with an elevation between 2000 to 2200 meters above sea level. It has a *Weina Dega* (medium to high land) climatic condition. It has both rainy and dry seasons with the average annual rainfall range from 50 to 250mm and has an average mean temperature of 19 degree Celsius. The master plan indicates that the total area of the city is around 76 sq km with more than 44452 housing units. According to the 2007 population census of the country, the city had 215,546 inhabitants [CSA, 2007]. The population of the city is increasing rapidly by both natural growth and migration from rural areas. The population growth and urban expansion leads to a challenge to both central and municipal authorities in providing urban infrastructure service in general and water supply in particular.

Existing water supply of the city

Huge investment in economic infrastructure is believed to be the precondition for the expansion of business investment and improvement of living standards of the people. Hence improvement and expansion of the infrastructural base of the city has been the main preoccupation of the Mekelle municipality. This includes, among others, road, electricity, housing and water. Water has been the most vital infrastructural facility that required top attention and a huge amount of capital for its expansion (MWSO, 2007).

Mekelle City Water Supply Utility was responsible for water supply between 1974 and 1984 under the control of the national Water Supply and Sewerage Authority. After the new regional (federal) structure had been put in place throughout the country, the responsibility was devolved and transferred down to the regions. Accordingly Mekelle city water service was re-established as an autonomous public utility under the city administration in 1984, under the control of the Mekelle Municipality in Tigrai Regional State (MWSO, 2007).

The national objective of the water supply and sanitation policy as specified in the Federal Democratic Republic of Ethiopia Water Resource Management Policy is to enhance the wellbeing and productivity of the Ethiopian people through the provision of adequate, reliable and clean water supply and sanitation service. In this regard the urban water supply is intended to provide water supply service to meet the human, livestock, industrial and other water customers demand.

Source and Production of Water

A surface water intake system is not accessible for Mekelle water supply. The major and the only water source of Mekelle city is from ground water of 18 deep boreholes having variable depths and yields. Out of these boreholes, 13 bore holes are located around ‘Tabia' Aynalem which is the major contributing source of the city’s water supply. In a local place called Quiha area there are 2 boreholes which supply to the same locality. In a place called Lachi area, there is one borehole which supplies to the surrounding beneficiaries through a direct pumping system. There are also 2 boreholes around Sewhi Nigus area of which one borehole is not working while the other one is used for non-domestic purpose because of poor quality.

According to Mekelle Water Supply Office the yield of the boreholes vary from 2 to 67 m^3/ hour on 24 hours pumping basis and the cumulative production of water was 4207059 m^3 in 2008/09 and the present production capacity is about 11526m^3/day

Table 1: Water production by year

Year	Production(m^3)
2003/4	2533162
2004/5	2634064
2005/6	3089546
2006/7	3564273
2007/8	3833727
2008/9	4207059

Source: Mekelle Water Supply Office

From the total production of water, about 22% is estimated to be wasted. Of the remaining, around 51% is distributed for private customers whereas 24% and 25% is consumed by business and government institutions respectively. In the city, there are19 water points (public taps) which serve the residents who do not have private connection of these taps; two of them are not functioning.

Customers, Distribution and Tariff system

The number and type of users over the period between 2006/7 and 2008/9 are presented below.

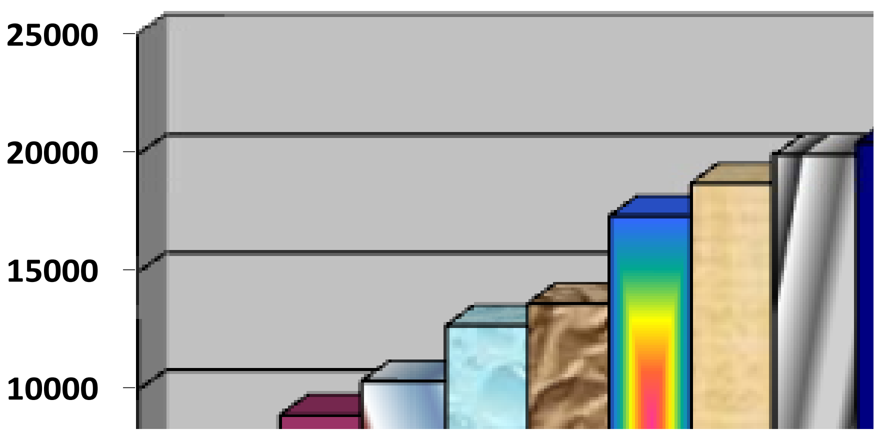
Table 2: Type and Number of Customers by Year

Type of Consumer	2006/07	2007/08	2008/09
Government	464	540	516
Private	17565	20518	21436
Business	1925	2185	2555
Total	19950	23243	24507

Source- Mekelle Water Supply Office

At present the MWSO has 24507 customers of these private connection constitutes. 87.4%; followed by business (commercial) users, are 10.4%, the government and institutional consumer's take 2.1%.

Figure 1: Overall Number of Customers by Year



Source- Mekelle Water Supply Office

The above chart shows that the number of customers has been increasing from time to time, especially in the period between 2002/3 and also after the new expansion of water source was made in 2006/07.

The Mekelle water supply office water distribution system has four distributional zones. Zone 1 of the system covers the south western part of the city and command by Enda Geebrial 2000m^3 reservoirs. Zone 2 comprises the central part of the city and supplied from Enda Gebriel 500m^3 reservoirs. Zone 3 is supplied from Enda Mariam 2000m^3 reservoirs and covers the North Western part of the town. Zone 4 is supplied from Enda Geiorgis 350 m^3 reservoir. This zone covers the eastern part of the city due to the topography of this area and it is sometimes difficult to distribute water to this zone.

The water supply system has more than 330 km of water supply lines with size ranging from 25 to 600 mm. Some of these lines had been laid before 55 years ago and some other lines were connected before 7 years ago as extension to new developing areas (Eyob Defer, 2007).

The city municipality office uses progressive tariff system which is based on the assumption that households in higher income group use a higher quantity and vise-versa so that cross subsidy is possible to lessen the cost of water service on the welfare of the poor. This system has been used since 2006/07. Previously, it was the uniform block system with 1.50 Birr for each additional m^3 of consumption.

A uniform block system of 6.10 Birr per m^3 is applied for business and government institutions. The increasing block tariff system is for private consumers. As indicated in Table 3, there are four tariff blocks applied to consumers with the lowest rate being Birr 2.30 for the consumption level between one and five m^3. The highest rate for consumers becomes the same as business and government institutions if the consumption level exceeds beyond 20 m^3.

Table 3: Tariff Structure of Mekelle city Water Supply Office

Private rate	Tariff rate(birr/m^3)
1-5	2.30
6-10	3.50
11-20	4.90
21 and above	6.10

Source: Mekelle Water Supply Office (MWSO)

2.2 Literature review

The supply of clean water in adequate quantity, among other things, is an integral part of any development venture. It helps to have a healthy and productive people who could be mobilized and effectively utilized for rapid economic development.

Thus, provision of adequate supply of potable water is essential (Bayrau, 2004).
The means of water collection importantly characterizes the way of consuming water and regulates other daily activities of the local population (Aiga, H., 2003). When the provision of water supply by public agency is absent or unreliable, people are forced to use alternative source of water such as dug-wells, streams, rivers or other surface water (e.g. open sewers in urban areas) unsanitary venders. Lack of clean water due to deficient infrastructure implies the risk of contracting infectious diseases (Chaka, 1998).

The health and economic costs associated with these conditions are enormous and represent formidable obstacles to the improvement of the living standards of the people. The prevalence of diseases and the potential for epidemics is closely linked to the accessibility of clean water and the success of the community in eliminating exposure to source of infectious diseases (Todaro, 2000).

Diarrhea disease is one of the leading causes of childhood mortality in developing countries. Household water treatment along with safe water storage and hygiene behavior intervention (hand washing and others) can reduce the number of diarrhea disease episodes by 50 percent (US AID, 2007).

The enormous economic cost resulting from lost productivity and the cost of medical care represents a drug on economic development; chronic ill health is both consequence and cause of poverty. It can contribute to poor nutrition, poor school performance, reduced productivity and permanent disability and, thus, give little hope for economic advancement. In addition to averting fatalities, improvements in the supply of water and sanitation reduce the incidence and severity of illness thereby reducing other costs associated with water borne diseases (Todaro, 2000).

Most developing countries including Ethiopia follow growth strategies that use labor intensive or a large human capital, healthy and productive human resources. Therefore, supplying of pure (safe) water is not only a political issue of countries; rather it is the way of keeping nations healthy which has indirect positive effect on the achievement of countries' goals.

Moreover, reducing the incidence of illness will help to reduce demand for medicine and there by easing balance of payment problem facing least developing countries which will have also a direct impact on productivity and production (Bayrau, 2004).

Based on the millennium development goals spelled out at the Johannesburg Environment Summit of 2002 call was made for the number of people living without water and sanitation to be halved by 2015. The question is how to achieve this goal or better. How to move beyond it to provide water and sanitation to all by that date? (Gasteyer, 2005).

As Malthus said, population naturally tends to grow geometrically or we can now say exponentially, in a finite world; this means per capita share of the world goods must steadily decrease (Hardin, 1968). According to the 2007 population census result Mekelle city has a total population of 215,546 (CSA, 2008). It is also believed that the growth or the total population growth is attributable to a combination of factors including continued migration from rural or country side, natural growth of population and to a significant extent displaced persons following the Ethio-Ertrea border conflict (MWSO, 2007). This increase in population size would definitely lead to an increase in demand for water.

Another reason for the rising demand for water is due to the improvement of living standards. In the country, generally, the per capita income of the nation has risen from time to time, which implies that as the nation’s income increase, it is obvious that the demand for normal goods also increases. Because of this, people need to consume more water not only for drinking purpose also for various other purposes.

On the other hand, when a country’s economic growth is at steady state with a growing population size, this leads to increase pollution and water quality hazard at the source (i.e. surface and ground water resource). Hence, stringent water quality monitoring is needed to make better use of scarce resources, in order to meet the insatiable demand of the fast growing population, urbanization and industrialization (Cleophas, 1997).

Most studies so far in this area on Ethiopia and elsewhere have focused on identifying factors that affect willingness to pay for improved water service and neglected determinants of demand that affects actual consumption. Since in urban areas, it is not only that the gap between demand for water and supply is a problem but also that the limited capacity of the supply is a contributing factor that influences the growing demand. Thus, there is a need to identify the most critical factors that affect the domestic water demand.

Most studies working on this sector, including Bayrau, (2004), Boadu, (1992), Chaka, (1998) and Fisseha (2006) used contingent valuation method (CVM) to estimate domestic water demand. The studies which used actual consumption to determine demand for water are very few.

Alaba and Alaba (2002) used binary choice model to identify determinants of water. To our knowledge, we find Hajispyrou, et al, who used water expenditure to determine the demand for water. This helps to see the actual situation and to draw more practical policy implications.

3. Methodology

3.1 Data source

In this study both primary and secondary data sources are used. Primary data are collected from cross sectional households of Mekelle city in 2009. Secondary data are obtained from different published and unpublished works of Mekelle Water Supply Office and Central Statistics Authorities (CSA).

A questionnaire was used for the primary data collection. In developing countries, water source characteristics and consumption depend on factors such as family's social- economic and demographic characteristics' as well as characteristics of the source (Alaba and Alaba, 2002). This study takes these and other determinants to determine the main factors that affect consumption of water from the existing source.

3.2 Sampling design

Recently, Mekelle city has been divided into 7 local administrations. In this study we have selected three local administrations which are found to be appropriate for this study. Basically the main aim for selecting these administrations was to get adequate representation of the different income groups of the city. At the initial stage, a problem was encountered with regards to obtaining information which can help classifying the different income categories. After a series of discussions with concerned bodies, we decided to take three local administrations randomly that have different economic status based on their residential house buildings and their location whether suitable for living or not.

Based on these criteria, Adi Haki is found as the location of good buildings and suitable for living condition. It is the best option that helps to get the higher income group of the city. On the other hand, Kedamay Weyane has been as a place where most houses and other infrastructures are not appropriate for dissent living condition. This place is believed to be the location where most of the lower income groups are found. Hadinet is the third location where both higher and lower income groups are found.

Another task was to allocate the sample size based on their proportion of population size. This was done by obtaining the size of population from each local administration office. A random sampling technique is used to select sample households from the total population of each local administration. The distribution of the sample size as proportional to population size is summarized in the table below

Table 4: Sample Selection Procedure

Local Administration	Population size	Percent	Sample size
K/weyane	38460	35.1	53
Hadinet	43200	39.3	59
Adi haki	28138	25.6	38
Total	109798	100	150

Source – Own Analysis

3.3 Theoretical framework and model specification

3.3.1 Theoretical framework

In urban areas drinking water is not different from public goods even if it is supplied by one agent which is largely driven by the need to improve the wellbeing of nations. Therefore it is appropriate to assume water to be similar to as other marketable goods.

According to the local non-satiation assumption, a utility maximizing bundle must meet the budget constraint with equality which implies that the whole income of the household is consumed without saving.

Assume that there is no change on consumption of other goods. Thus, utility of a given household depends on consumption of water which is affected by a vector of s_i water source characteristics such as reliability and a vector of z_h household characteristics. The indirect utility function of household *h* is written as:

$$\max u_{ih} = u_{ih} \ (s_i, z_h) \qquad (1)$$

$$s.t \sum (w_h t + y_h) = c_h$$

Where s_i – existing water source (i) characteristics which affect household utility

z_h – Household 'h' socio-economic characteristics affecting differences in taste and preferences among households.

w_h, t, y_h and c_h represent household's wage, time spent for work, income other than wage(exogenous income) and consumption of composite good of the household respectively.

Note that the quantity of consumption that gives the maximum utility will be given as the function of observed variables which are taken as the most determinant for consumption of water and the second variable is that unobserved variables which are not captured by this study are assumed to have little positive or negative effect with a mean effect of zero.

3.3.2 Empirical model

From the theoretical formulation outlined above the empirical model can be specified as:

$$Q_{ih} = f(v_{ih}, e_{ih}) \quad \textbf{(2)}$$

where v_{ih} is deterministic component, e_{ih} – stochastic component, and Q_{ih} is quantity of water consumption of the household.

Based on Equation (2) and assuming a semi-log form of demand function, the empirical is specified as:

$$\begin{aligned}\ln Q_{ih} = {} & b_0 + b_1 inchh + b_2 aghh + b_3 genh + b_4 typoc + b_5 eduleh + b_6 reaws + b_7 fswbd + \\ & b_8 nohmm + b_9 ownh + b_{10} tilo + e_{ih}\end{aligned} \quad \textbf{(3)}$$

where b_i's are coefficient for deterministic variables where as e_i's are stochastic components.

3.3.3 Variables and hypothesis

The following are the variables considered as determinants for the demand of water.

Gender (**gen**): It is the sex of the household head. We assumed that if the family is headed by women (gen12) they are expected to have a higher demand for consuming more water than a family headed by men (gen11). Women perform the majority of in-house activities and thus they wish to use high quantity of safe water. However, the sign of the variable is ambiguous or cannot be set a priori since in most developing countries women are economically dependent and cultural barriers thwart them from making decision. A dummy value of 1 is given for this variable if the head is female and 0 otherwise.

Age(aghh) represents age of the household head which is a continuous variable.

Since older people tend to use traditional or lower cost alternative source us they are likely to use or consume lesser amount of safe water. Thus, this variable is expected to have negative sign.

Education (eduleh) captures the education level of the head. The assumption is that if the head of the household is educated, he or she would be aware about health implications of clean water. They are not willing to lose their time and money to consume water from unsafe source since their opportunity cost for their time is high. Thus, they prefer to get safe water in their house and consume a higher quantity. Therefore, this variable is expected to have a positive sign.

We take this variable by classifying it into 5 sections which are no level (eduleh15), elementary (eduleh11), junior (eduleh14), high school (eduleh12) and high institution level (eduleh13).

Family size (nohmm**)** – Number of household members or family size is one of the determinants of demand for water. There are two contradictory views regarding the sign of this variable. The first is that when the number of family size increases, it's obvious that the family would consume larger volume of water proportional to their size. The other view is that especially in most developing countries where most of family members are unemployed or dependent on the income of the family head, share of expenditure on water will decrease as the family size increases. Therefore, it is difficult to decide the sign of this variable a priori.

Ownership of house (owh): It represents owner of the house and it is a proxy variable for wealth. It is believed that rich persons consume water not only for essentials like drinking and washing but also for water for livestock and other purposes. This variable takes a value of 1, if the family owns a house (owh11) and zero if household lives in rented house (owh12). This variable is expected to have a positive sign.

Income (inchh): It denotes income of the household and it is continuous explanatory variable. This study, since people do not want to tell their income directly, tried to inquire different sources of income in detail and try to compare with the average monthly expenditure of the household. Given that water is a normal good, its consumption increases with an increase in the income. Empirical literatures also support this idea, thus positive sign is expected.

Time loss (tilo): The demand function is specified based on Nigeria (Alaba, and Alaba, 2002). The study implies that reduced collection time may positively affect the quantity of water demanded, where inadequacy of water availability affects the time spent for fetching water. In our observation, we see that most consumers use piped water source. Thus, we take this variable as the time spent to collect water from other sources (could be other pipe) where water is available when their own pipe water source is not available. When the time loss for fetching water from other source increases their consumption is negatively affected; therefore; the expected sign is negative.

Occupations (typoc) **–** this variable has dummy value. We use this variable by classifying into 3 groups that are unemployed (typoc13), formally employed (typoc11) and informally employed (typoc12). In the analysis, we take unemployed who are not engaged in any productive work as a reference. Theoretically, it is believed that workers who are engaged in any productive sector earn better income than those who are not engaged in any productive work. Since income positively affects health, it is also expected to have a positive relationship. Empirical findings show that this relationship might be either side and thus sign is difficult to set in this study too.

Reliability (reaws) – this variable has 1 if the existing water source is not available at the required time and amount (reaws11) and zero if it is not the case and denoted by (reaws12). If the existing source is available within the required time and amount, they prefer to use from the existing source as much as they require. Otherwise, consumption is expected to reduce if the reverse is true. Therefore we expect negative relationship between not reliability and consumption.

Water-born disease (fswbd): This dummy variable is given a value of 1 if any member of the family has the experience of any type of water-born disease (fswbd11) and 0 otherwise as denoted by (fswbd12). The sign of variable is expected to be positive which is based on the implication that if any member of the household suffers from any water-born disease for the previous period. It is because of the fact that households which suffered from some kind of disease in the past would tend to consume higher quantity of water after that period.

In the empirical analysis, we used Ordinary Least Square (OLS) to derive the coefficient estimates for the variables.

4. Results and discussion

4.1 Descriptive analysis

Socioeconomic Characteristics of Respondents

The study is conducted by taking 150 households as the representatives of the total population of Mekelle city. Around 26% households are female headed. The average age of the household heads is around 52 years whereas the youngest and the oldest head of household are 18 and 75 years. The average family size is 4.59 and the maximum and minimum family size is 8 and 1 respectively.

Table 5: Socio-economic characteristics of the sample households by Income group

Characteristics	Income group		
	Below 2000	**2001-4000**	**Above 4000**
Age (average)	49.4	54.5	52.3
Education level			
- No level	10	16	6
- Primary	11	8	4
- Junior	6	8	4
- High school	5	12	6
- Higher institution	20	12	22
No of family			
Average	3.92	4.9	4.9
Maximum	7	7	8
Minimum	1	2	2
Ownership			
House	39	47	37
Television	44	55	43
Radio	48	55	43
Tape	49	54	42
Telephone	32	48	43
Refrigerator	21	33	43
Type of occupation			
Formal	27	22	25
Informal	8	19	13
Unemployed	17	15	5

Source: Own computation from the survey data.

The education level of sample households varies from post graduate to no education. The sample is composed of 36.4% as graduates of higher education, 12.5% as high school complete, 14.6% as junior secondary and 15.33% as elementary. Household heads that are not educated constitute 21.2%. About 76% of the household heads engaged in productive work and the rest are not engaged in any productive work during the year. From the household who are engaged in productive work 49% work in formal sectors whereas 26.49% work in the informal sectors. The average level of income of respondents is 3829.28 Birr. 52 households earn income less than 2000 and 56 households earn in the range of 2001 – 4000 whereas 42 households have income above Birr 4000. Around 80.7% of households live in their own houses while the rest live in rented houses either from kebele or private. The average stay in the house is 11.32 years with the longest 40 years and the shortest 1 year.

Let's now look at the socio-economic and demographic characteristics of the sample households classified into three income groups: households earnings is less than Birr 2000; households with income between Birr 2001- 4000 and households earning more than Birr 4000.

Income, expenditure and water consumption

The income of households received from different sources during the year is summarized below. For the sampled households, the average monthly income earned during the year is Birr 3829.8. The lowest income is 500 Birr and the highest is 35000 Birr. We look their expenditure also by classifying into each and every type of expenditure item as food expenditure and non-food expenditure. Here is present by summarizing into food and non-food expenditure. We find that the average expenditure of the total sample respondents is Birr 2064.9 with the lowest and the highest expenditure being Birr 483 and Birr 7230 respectively.

Table 6: Income and expenditure structure and water service in ranking

Type	<2000	2001- 4000	>4001
Income			
Average	1300	2885.28	8221.14
Highest	2000	4000	35000
Lowest	500	2050	4100
Expenditure for food			
average	1118.6	1400	2587
minimum	448	430	1061
maximum	2938	2913	5942
For non-food			
Average	181.5	298.2	442
Minimum	35	75	101
Maximum	900	711	1220
Ranking of water			
1^{st}	28	37	31
2^{nd}	17	17	10
3^{rd}	7	2	1

Source: Own Computation based Survey Data.

The average monthly expenditure for water is Birr 37 whilst the maximum is 180 Birr. The lowest payment is found to be 4 Birr. Sampled households are also asked about their perception of the importance of different services such as water, school, health, road, power, telephone and toilet (sanitation). The majority, that is 64% households put water as the most important, 29.3% households believe it is the second most necessary service following health, and for the 6.6% of the households it is the third most important service. Income, expenditure and perception of the service of respondents by income group are summarized in Table 6 below.

We look at the existing condition of water consumption expenditure and consumption quantity in relation to their income group, as that helps to find out the characteristics of the water as well as the consumer response based on their consumption.

Table 7 shows the relationship between household income and expenditure (water consumption). In the first row, we can see how water consumption increases with an increase in the level of income implying that water is a normal good. We have specifically seen the difference between lower group and middle to be very small. It can also be seen that the share of expenditure on water decreases as one moves from lower income group to higher income group implying that water is necessity good.

Table 7: Water Consumption, payment and income share by income group

	< 2000	2001– 4000	> 4000
Average consumption(m3)	9.738	10.56	13.93
Average payment	29.6	32.919	49.95
Income share	.0265	.011	.0073

Source: Own computation based survey data.

Existing source conditions

The majority (93%) households use water for all purposes except for livestock. The remaining 7% respondents use it also for livestock consumption. About 98.6% households have tap inside their house, whereas 1.4% households use taps outside their house which is privately owned. Only 0.67% respondents have the perception that the existing tariff for water supply is cheap. About 55.3% believes that the tariff is reasonable and the remaining 44% consider is expensive. Sampled household responses are used to judge the existing supply condition by looking at the reliability, sufficiency and quality of the services. About 81.4% say that it is not sufficient while the rest say it is sufficient. Perception of quality is that 49.1% believe that the water is not safe but 50.9 say it is good. Of the households say the existing water supplied by the town water supply office is not good, 86.48% households use purification method but 13.5% do not use any purification mechanism because they believe that even if the water is not clean, it is so expensive and time taking to use purification mechanism.

From the total respondents 87.33% believe that the reliability of the existing water supply by the service is not good while the rest 12.67% say it is fine. Its reliability by taking its time frequency as 18% household get water both the day and night time but 33.34% that water is available only during day time and 18.67% household get water only during night time. But for 30% of the household it is unpredictable.

Within the least income group (< 2000), 96.2% of the respondents use water for all domestic purposes except for livestock whereas only 3.8% households use it for livestock consumption as well. Within the middle income group, 7.14% households use for all purposes including livestock; for the higher income households with income above 4000, we find 4.76% respondents use for all purpose whereas 95.23% use it excluding livestock consumption.

In addition, 55.7%, 51.7% and 57.14% households in the lower, middle and higher income categories respectively believe that the tariff rate is fair or reasonable. Whereas 44.2%, 48.2% and 40.5% respondents in the lower, middle, higher income category respectively believe that it is expensive. Only 2.3% respondents in the higher income category say that it is cheap. Coming to the level of existing condition of water which is supplied by the town water supply office, it is important to look at the sample responses of households. Only 18% of all sample respondents get water sufficiently which is found to be evenly distributed for the entire income groups. When this number is disaggregated for the three groups, 17.3%, 16.1% and 21.4% lower, middle and higher income groups responded that the water supply is sufficient respectively. Around 82.69%, 83.9% and 78.5% lower, middle and higher income category responded that it is not sufficient. With regards to reliability, only 15.38%, 10.7% and 11.9% households for the lower, middle, higher income respectively say it is all right. According to 84.6%, 89%, and 88.0% respondents in the lower, middle and higher income category respectively it is not reliable.

Another problem is the quality; this is finding better than other problem where 46.15%, 41.07% and 64.28% respondents from each respective income categories suggest the existing water quality is safe and others that is 53.8%, 58% and 35.7% in the respective income categories think the quality is not good. From those who say the quality is not good 30%, 37.5% and 64.2% from each income group respectively use purification method to make the water safe. Boiling, uses of purification machine and purification powder are the most commonly use methods for the sample households. We find also 11%, 7%, 2% respondents in the respect on lower middle and higher income category have experienced water born disease during the year.

Regarding the time of availability only 21.1%, 17.8% and 9.5% households in the respective income group get water both day and night. About 42.3%, 23.3% and

38.1% get water only during the day time. The remaining 34.6%, 39.3% and 35.7%, get water only night time. Around 26.9%, 14.3% and 16.6% say that the time of availability is unpredictable. The average availability of water during the week is 3.2, 3.5 and 2.95 days in the respective income categories whereas the maximum day is 6, 5 and 6 and the minimum is 1 per week for respective income categories.

Table 8: Summary Statistics of Variables Used In the Analysis

Variables	Mean	St.d	Min	Max
Inch	3829.873	4410.97	500	35000
Aghh	52.18667	10.61934	20	75
genh12	0.26	0.4401037	0	1
typoc11	0.4866667	0.5014966	0	1
typoc12	0.2666667	0.4436981	0	1
eduleh11	0.1533333	0.3615156	0	1
eduleh12	0.1266667	0.3337134	0	1
eduleh13	0.36	0.481608	0	1
eduleh14	0.1466667	0.3549585	0	1
reaws11	0.8733333	0.3337134	0	1
fswbd11	0.0733333	0.2615562	0	1
Nohmm	4.593333	1.541797	1	8
ownh11	0.8066667	0.3962351	0	1
Tilo	11.4	16.12784	0	60

Source: Own computation based on survey data.

On the other hand, its reliability based on the response is that 9.6%, 14.3% and 9.5% of the households in the low, middle and higher income groups respectively say it is well. Around 65.4%, 44.6% and 26.2% respectively consider the service as fair. 19.2%, 41.0% and 47.6% say it is poor and 9.6%, 1.7% and 14.3% believe it is very poor. It is also found that when their piped source is not available, 46.15%, 42.8% and 40% in the low, middle and higher income groups respectively buy water whereas the rest from each income group have their own reserve. For those who buy from others, they pay on average 31.3 cents per jerry can or 20 litters. The maximum payment is 1 birr/ jerry can for the lower income categories, for the middle income it is on average 40.9 cents for the maximum is 2.50 Birr. For the higher income, the average pay is 37.4cents/jerry can while the maximum is 2.00 birr. The average time lost to fetch water from these sources is about 13, 10 and 9.5 minutes for the different income groups. The maximum time lost is 60 minutes for all households at different income levels when they go to these sources at a time.

4.2. Econometric analysis

This section presents regression result of most important determinant factors which have influence for domestic water demand. This analysis is based on equation (3) for the theoretical functional form and for empirical analysis using OLS econometric method. With cross sectional data like this we expect heteroskedasticity problem and this could result in underestimation of the standard error and thus an overestimation of t value, thus we employ equations estimate in semi log form to take care of hetroskedasticity problem (Maddala,G.S., 1992). But due to some variables such as socio demographic characteristics which are inappropriate to apply logarithm expression thus we limited to use semi log.

Before directly going to the result discussion, present some test result that helps to be sure whether our estimation are valid or not.

For the hetroskedastcity, we use Breusch - pagan test with the null hypothesis constant variance and we find that the p value (.13) is almost fine to accept the null hypothesis.

Normality of the residuals distribution was tested using skewness/kurtosis and we got the p value is very small (.0008) which is sufficient to reject the null hypothesis implies normal distribution of residual term.

If we are dealing with a small or finite sample size say data less than 100 observations the normality assumption have critical role. It is not only helps us to derive the exact probability distribution of OLS estimator. But also enable us to use the t, F and x^2 statistical tests for regression models. If the sample size is reasonably large we may be able relax the normality assumption. (Gujirati.D, 2004)

Multi colinearety problem also tested using variance inflation test and we find that the mean variance inflation is 1.68 which is less than 10 that implies there is no correlation between variables.

Finally to test **the** overall fit of the model, we use adjusted R- square which is equal to .45 implies that 45% our dependent variable (demand) is explained by our regress variables.

Regression result shows that most of the determinants have the identical sign as expected from the hypothesis; the result and respective significance values are summarized in table below.

Table 9: OLS estimation result of determinants of demand for domestic water

Variables	Coefficient	b/std.Err	P value
Const	1.787226***	10.75	0.000
Inch	0.0000167***	3.12	0.002
Aghh	-0.0019157	-0.72	0.470
genh12	0.0417017	0.78	0.439
typoc11	0.2893482***	3.80	0.000
Typoc12	0.1228931*	1.81	0.073
eduleh11	0.0071712	0.09	0.925
eduleh12	0.0692182	0.81	0.420
eduleh13	0.2328767***	2.99	0.003
eduleh14	0.238034***	2.98	0.003
reaws11	-0.0792436	-1.19	0.235
fswbd11	0.1085694	1.21	0.228
Nohmm	0.07852***	4.25	0.000
ownh11	.0415776	0.71	0.479
Tilo	-.0037441***	-2.64	0.009

Number of obs = 150
F(14, 135) = 10.01
Prob > F = 0.0000
R-squared = 0.5093
Adj R-squared = 0.4584

*** 1% significance, ** 5% significance, * 10% significance

Income has positive sign and significance at 1% level. Starting from its sign that implies an increase in income of the household result also a percent increase in quantity consumption. Its effect is that one birr increase income of the household contributes .00167 percent increase in for consumption taking other factors as unchanged. This result shows that water is a normal good and consumption increases with increasing of income as discussed from hypothesis.

Occupation: we get these variables have significant contribution on demand for water. Particularly the formal type of employment is significant at 1% while for informal type of employment it is significant at 10 percent. In both cases have positive sign also shows those employed have more consumption of water than those who are not employed. Its coefficient magnitude is .2893482 for formal employers, which implies when the head is employed in formal sector their consumption of water increases by 28.9 percent than those who are not employed where other things are the same.

In the case of household heads engaged in informal sectors their consumption of water rises by 12.28 percent than those who are not engaged in any productive work holding all other things are unchanged. Thus we can say those who engaged in productive work take better care of their health and their family health through consuming higher quantity of water.

Variable education is capture by taking no education as a reference. In all cases the sign for education variable is positive which means educated household heads consume more water than those who are not, even if the significant variables are only higher institutional level (eduleh13) at 1% and also for junior level (eduleh14), which is significant at 1%.

By taking all other factors are remaining constant, which household head whose education up to junior and higher institution level of education consume 23.8 percent and 28.28 percent more as compare with those who are not educated. Based on this result it is possible to say that when the household heads are is more educated especially when they have an experience to stay in higher institutions they are more aware of health and sanitation and they use water for multipurpose; that is why they consume higher volume of water.

Family size has a positive sign, starting from the sign it is true that when members of the family increase the demand of water consumption rises too. Based on our regression result, an increasing number of family sizes have influence on consumption with a coefficient .07852 suggesting that when the number of the family adds one member, their consumption of water is increase by 7.85 percent. We get also this variable is one of the most important determinants and significant from our explanatory variables with 1% level of significance.

Time loss to fetch water is one of the significant variables at 1% level and its sign is as expected in the hypothesis. There is a negative effect time loss to get water from other source when water is not available on own source and consumption. Its coefficient is .0037441 which implies that when the time spent to get water from other pipe increases by a minute, their water consumption decreases by .3744 percent holding other variables unchanged.

6. Conclusions and recommendations

This study analysis the most important determinants of demand for water, household characteristics and the existing source characteristics taken as the most important determinant (which is derived from primary data collected from 150 representatives of the Mekelle city) data used in the analysis and other relevant office.

We employ Ordinary Least Square (OLS) econometric method for the regression analysis and also descriptive analysis too.

From our result, we find income, occupation and education are the most important determinants which affect consumption of water positively. Particularly, as income of the households increases their consumption of water increases too. This result shows that water is a normal good. A household head who is working in formal sector consumes a higher quantity than those who are not engaged in any productive work. Additionally, household heads who are educated especially who got the opportunity to join a higher institution have better awareness for health and sanitation and consume higher amount of water than others.

We find that number of family members have positive and significant contribution for consumption of water. This is expected because, as the family size increases it is expected to increase their demand for water consumption at least to satisfy their minimum requirement.

On the other hand, time loss to collect water when own source is not available is the most determinant that affects consumption of water negatively. From our study we find that the main existing water source problem is reliability that has negative impact for their time and also their money indirectly affect their demand for water. Our result also supports the idea that, when the time spends to get water from other source when their own water is not available induce, the customer's response by decreasing their consumption.

Thus based on our result we may propose the following recommendations:

- Education is the most important significant factor for demand (consumption) of water; this implies that as the household head becomes educated the demand for water will increase. It is known that more educated societies have a better well knowledge about the health implications of safe water and care for their family. Thus in order to have productive societies who are safe from water born disease, there should take action in educational awareness but it has influence on the growing water demand problem within the existing supply condition. Imply for forward looking water supply service in light of the education sector is essential.
- The positive relationship between income and quantity demand for water indicates that higher income groups consume a higher quantity of water at the same time paying a higher amount than lower income groups. Therefore, strengthening the income of lower income groups9 helps to increase their ability to consume higher quantity and paying with higher tariff which have indirect implication for financial strength of supplier side.
- A positive relationship between family size and demand is an indication of a large family size household consumes a higher quantity of water at least to get a minimum requirement of water. On the other hand, there is a limited financial capacity on the supplier side. Thus the increase in family size affects the gap between demand and supply; therefore policy on population will have crucial importance to narrow this gap.

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HOUSEHOLDS' CHOICE OF AND SATISFACTION WITH DRINKING WATER SUPPLY IN RURAL ETHIOPIA

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1. Introduction

Access to and utilization of safe drinking water has an immense contribution to health and social development. However, many people, particularly in developing countries continue to still rely on unimproved water sources. According to UNDP (2006) nearly one-sixth of the World's population obtained their water for drinking from unimproved sources. Inadequate access to safe drinking water is a widespread problem especially in developing countries. In sub-Saharan Africa, for instance, the proportion of the population who are dependent on unimproved sources declined only slightly from 52% in 1990 to 44% in 2004.

The international community has set a goal of reducing the proportion of people without sustainable access to safe drinking water by 50% in 2015 compared to its level in 1990 (UN, 2004). Indeed, physical access to improved sources of drinking water has gradually improved worldwide (UNDP, 2006). However, whereas expanding improved water infrastructure is necessary, it alone does not guarantee safety and adequacy of water to its users. Put in other words, access is an intermediate output and has to be combined with favorable demand to generate desired outcomes among users (Larson *et al*., 2006). In most cases, improved water schemes which have been constructed are frequently not used appropriately or properly maintained (World Bank, 1993). Recent evidence from empirical research (e.g., Vasquez *et al*., 2009; Kleemeier, 2000) also indicates that improved water supply schemes in many developing countries are not functioning properly. In sub-Saharan Africa, for instance, it is estimated that 35% of all rural water systems are not functioning (Baumann, 2005 cited in Harvey and Reed, 2007). Other authors (Vasquez *et al*., 2009; Deichmann and Lall, 2007) also reported drinking water safety

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and reliability as key problems even when the basic water delivery systems are in place. Thus, "in addition to increasing access through implementation of improved water supplies, it is also necessary to ensure that both new and existing water systems are sustainable, so that access to safe water is sustained for all" (Harvey, 2008, p. 117).

Despite the importance of providing safe and reliable drinking water for poverty reduction and social development, relatively little is known regarding users' satisfaction with rural drinking water services in developing countries particularly in sub-Saharan Africa. Investigating users' evaluation these services is increasingly seen as an important means for improving the performance of public services and utilities (Deichmann and Lall, 2007). This paper attempts to shed light on this issue for rural households in Ethiopia. Our main purpose is to examine the main sources of drinking water used by people in remote rural localities and to investigate whether access to improved water supply has increased users' satisfaction with respect to quality and availability. The paper uses cross-sectional survey data collected in 2009 from 1117 rural households residing in eight districts.

The remainder of the paper is structured as follows. The next section presents background information on drinking water situation in Ethiopia. Section 3 describes our methodology and focuses on the empirical model used for our data analysis and the sampling procedure that has been adopted to draw observation units. Section 4 presents the results and discussions of the paper followed by conclusions and policy implications in section 5.

2. Background information: drinking water supply in Ethiopia

Ethiopia has long been characterized by limited access to safe drinking water and sanitation services. In 1990, for instance, only 19% of the population had access to safe drinking water supply in the country. By 2007 the official clean water coverage rate reached 52% (MoFED, 2008). However, despite this improvement, the rate still remains below the sub-Saharan average of 67% (UNDP, 2009). Many people obtain their drinking water from an unimproved water source. In 2005, for instance, about 44% of the country's population obtained its drinking water from unimproved water sources and an estimated 52% traveled half an hour or more to collect it every day (EDHS, 2005).

In Ethiopia, unsafe drinking water is one of the main causes of diarrhea incidence among children under the age of five (EDHS, 2005). The negative health impact on health of contaminated water is exacerbated because over 90% households consume this water without any treatment before using it. Previous empirical studies elsewhere (see e.g. Jalan and Ravallion, 2003; Esrey, 1996) show that access to improved water is an important contributor to improved child health and mortality reductions.

Table 2.1: Percentage of Population with Access to Safe Drinking Water, Selected Years

	1996	1998	2000	2004	2006	2007
Rural	10.0	14.0	17.0	25.0	41.2	46.4
Urban	72.0	84.0	92.0	92.0	78.8	82.0
Total	19.0	24.0	28.0	36.0	47.3	52.5

Source: MoFED (2006, 2007)

According to the EDHS (2005), 52% of the households in the country travelled half an hour or more to fetch water every day. The long travel distance directly affects women and children because they are the main persons responsible for fetching water in Ethiopia.

In recognition of the deep-rooted water problems in the country, especially in rural areas, the government has increased resource allocation to provide safe drinking water. As a result, access to improved water supply increased from 19% to 52.5% between 1996 and 2007. However, the access still varies across geographic regions in the country, and the problem is more pronounced in the rural areas than in the urban areas. Moreover, as in many other countries in sub-Saharan Africa the water infrastructures may not be operating properly due to various problems. According to recent report by UNDP (2006), 29% of hand pumps and 33% of mechanized boreholes were not functional because of the lack of maintenance.

3. Determinants of satisfaction

The measurement and analysis of satisfaction has received increased research focus in various disciplines including economics, public administration, psychology, and marketing. As indicated in Deichman and Lall (2007), satisfaction can be modeled as a function of citizens' prior anticipation of the performance of a product or service and the actual performance, as perceived by them. In other words, "expectations serve as an anchor to the evaluation of performance" (Deichman and Lall, 2007, p.652).

In applied research, measuring satisfaction is a difficult task. However, it is assumed to be related to personal and economic characteristics such as age, gender, education, income, and wealth, which in turn influence one's satisfaction with the delivery of services. Previous studies in economics indicate that females and older people have larger satisfaction but that satisfaction levels strongly decline with the level of education (Clark and Oswald, 1996).

Empirical studies of client satisfaction with public service delivery have received increased attention in recent years. Using data from a New York City Citizen survey, Van Ryzin (2004) has found that citizen satisfaction with urban services is closely associated with the actual performance of the services and citizens' initial expectations about these services. In a developing country setting, Deichmann and Lall (2007) provide empirical evidence on the determinants of client satisfaction with of public services using a micro- econometric approach. These authors have found that wealthier households are more satisfied with the duration of water. But they also have reported that satisfaction levels are significantly decreased with household size and among male-headed households.

4. Methodology

4.1 Empirical models

This section outlines the empirical model we use to explain households' satisfaction with drinking water supply services. In particular, we focus our attention on water quality and availability from the major drinking water sources used by households. As such, the dependent variables represent the degree to which respondents are satisfied with water availability and quality he/she obtains from the main source. As indicated in the next sub-section, relevant data on these issues were provided by the main persons responsible for fetching water to the household by administering survey questionnaires to both spouses. When the husband and the wife express sharing responsibility for fetching water, we use the 'water data' from the wife's response since she has more exposure to and knowledge about water availability and quality for domestic use. In this paper, drinking water sources are classified into two categories, namely improved water source and unimproved water source. This classification was used to facilitate our empirical analysis of to what extent obtaining access to water sources regarded as 'improved' enable the intended users to increase users' satisfaction with respect to water quality and availability. A household is considered to have access to an improved water source if he/she gets its drinking water primarily from a private stand pipe, public stand pipe, protected spring, dug-well with a pump, rain water, or a tanker and water vendor. Drinking water sources such as unprotected wells, and rivers, lakes and pond are regarded as unimproved water sources.

Suppose, S denotes the observed satisfaction rate reported by a household. S takes a value one if the household is very satisfied/satisfied with the quality/availability of water and zero otherwise.[3] The observed response variable S is related to an unobserved latent variable S^* as follows:

$$S_i = 1 \text{ if } S_i^* = \alpha_{1i} X + \alpha_{2i} W_i + \varepsilon_{1i} > 0 \text{ and}$$
$$S_i = 0 \text{ if } S_i^* = \alpha_{1i} X_i + \alpha_{2i} W_i + \varepsilon_{1i} \le 0. \quad \textbf{(1)}$$

Where, X is a vector of socioeconomic variables, and W dummy variable with a value of 1 if the major drinking water source is an improved source and 0 otherwise; α_1 is a vector of parameters to be estimated; α_2 is the coefficient of our interest and ε_1 is a disturbance term with $E[\varepsilon_{1i}] = 0$ and $\mathrm{var}[\varepsilon_{1i}] = 1$ and i indexes households.

Equation (1) gives unbiased parameter estimate of α_2 assuming that W is an exogenous variable. However, there is a concern regarding the validity of this assumption. In particular, the placement of improved water sources may be determined by certain factors and raise endogeneity problems. Along this line, previous studies (e.g. Larson *et al*., 2006; Briand *et al*., 2009) show that the type of water sources used by households in developing countries are related to their socioeconomic, among other factors. From the supply side, service providers (e.g. government, non-governmental organizations, community-based organizations) may also use demand factors or local need to construct improved water schemes in rural areas. Factors which influence the choice and placement of improved sources lead to misleading conclusions if (a) these factors cannot be captured through appropriate location and other variables included as right hand variables, and (b) there is some reason to think that non-captured (and thus omitted) variables are likely to be correlated with the dependent variable, i.e. satisfaction. Simultaneity may also become another source of endogeneity. Households who for whatever reason have been and continue to be quite satisfied with their, say, unimproved source are also likely to stick to this source even if an improved water source a bit further away or requiring user-fees becomes available. To the extent the extent that these problems are true, simple comparisons satisfaction rates of households fetching water from improved sources and of households getting water from unimproved sources would lead to biased estimation results. Thus, to test and control for possible endogeneity of water source choice variable in our satisfaction model, we construct a bivariate probit

[3] Initially, respondents were asked to report their satisfaction levels on a four-point Likert scale (4= very satisfied; 3=satisfied; 2=dissatisfied; 1=very dissatisfied).

model.[4] In this respect, latent variables that define choice of a water source and reported satisfaction with water quality and availability are given as follows:

$$
\begin{aligned}
&S_i^* = \alpha_{1i} X_i + \alpha_{2i} W_i + \varepsilon_{1i} \\
&W_i^* = \beta_{1i} X_i + \beta_{2i} Z_i + \varepsilon_{2i} \qquad \textbf{(2)} \\
&E[\varepsilon_{1i}] = E[\varepsilon_{2i}] = 0, \operatorname{var}[\varepsilon_{1i}] = \operatorname{var}[\varepsilon_{2i}] = 1 \text{ with } \operatorname{cov}[\varepsilon_{1i}\varepsilon_{2i}] = \rho
\end{aligned}
$$

Where, $W = 1\, if\ W^* \succ 0$ and $W = 0\, if\ W^* \leq 0$;
$S = 1\, if\ S^* > 0$ and $S = 0\, if\ S^* \leq 0$; X is a vector of exogenous variables, Z is a vector of instrumental variables. ρ measures the correlation between unobserved or omitted factors in the source and satisfaction equations. α_1, β_1 and β_2 are vectors of regression parameters to be estimated and α_2 is the coefficient of interest. The variables S^*, X_i and W_i are defined as before. A Wald test of ρ is employed to test the exogeneity of S and W (Wooldrige, 2002). If ρ is not significantly different from zero then equations (1) and (2) can be estimated using univariate probit models. However, when ε_1 and ε_2 are not independent, estimating equations (1) and (2) jointly in a bivariate probit framework will provide consistent estimates.

Appropriate instrument Z is needed to control for possible endogeneity W using equation (2).

In this regard, the main step toward arriving at an unbiased parameter estimate of c is to find a good instrument(s) which predict W well but do not have a direct influence S.

4.2 Sampling procedure and Data

The empirical data for this paper were collected as part of a larger study of rural services and water supply by EEA-IFPRI in Ethiopia. A multi-stage sampling procedure was used for the selection of observation units. First, eight districts were purposively chosen from seven administrative regions (Tigray (1), Amhara (2), Afar (1), Oromia (1), Benishangul (1), SNNPR (1), and Gambella (1)). Second, we randomly selected 32 Kebeles (four *kebeles* per district). And finally, a total of 1120 households were randomly drawn from the 32 Kebeles.

[4] A bivariate probit model is an appropriate model when a dependent variable and an endogenous explanatory variables are both binary (Wooldridge, 2002).

The data used for this paper were elicited using a structured household questionnaire. The questionnaire included several modules and all the questions were translated into Amharic language. The questionnaire was administered to both spouses of the household. Data collection took place between April and June 2009. The survey data were collected on various topics including drinking water, agricultural extension and credit, demographic and social variables, road and communication and other infrastructure conditions. Survey team training, field supervisions, data cleaning and verification, and data double entry procedures were accomplished to increase data quality and reliability.

5. Results and discussion

5.1 Descriptive Statistics

Table 5.1 shows descriptive summary characteristics of the sample households used in our empirical analysis. The sample households are almost equally divided into the eight survey districts. In terms of drinking water supply, about 29% of the households in our sample obtain drinking water from sources regarded as improved. Interestingly enough, we do not see any seasonal variation in terms of access to an improved water source. However, perceived satisfaction with the quality and availability of water show some degree of variation between dry and rainy seasons (see Table 5.3 for further details).

The descriptive statistics in Table 5.1 indicate that 78% of the households in our sample are headed by males. Education of household head is fairly low. The fraction of the sample household heads who can read and write is just 39%. Agriculture is the main occupation for nearly 85% of the household heads in the sample. Overall, our sample households are characterized by the limited access to sanitation and mass media information. The proportion of households who use improved latrine and own a radio stands at only 34% and 18%, respectively. Nearly, one in three households in the sample possess a pack animal.

In looking at household responsibilities for fetching water the descriptive results (not presented here) indicate that women and children are responsible for this task in over 90% the sample households.

Table 5.1: Description of variables and summary statistics

Variable	Definition	Obs.	Mean	Std dev
Dependent variables				
Water source	1= if improved; 0=otherwise	1119	0.289	0.453
Water quality	1=satisfied; 0=otherwise	962	0.522	0.499
Water availability	1=satisfied; 0=otherwise	963	0.698	0.458
Independent variables				
Age	Age of head of household in years	1112	43.289	14.949
Sex	1=male, 0=female	1117	0.783	0.412
Education	education of household head, 1=literate; 0=otherwise	1112	0.388	0.487
Adult females	Proportion of adult (age>15) females in the household	1117	0.617	0.486
Household size	Number of persons in the household	1117	5.681	2.517
Radio	1=owns a radio; 0=otherwise	1114	0.314	0.464
Ox	1=if household owns ox; 0=otherwise	1113	0.489	0.5
Pack animal	1=if household owns a pack animal; 0=otherwise	1113	0.309	0.462
Light	1=if main source of light is non-biomass fuel; 0=otherwise	1112	0.649	0.477
Roof	1=if roof of house is mainly made of iron sheet; 0=otherwise	1112	0.177	0.382
Latrine	1=if household has an improved latrine; 0=otherwise	1112	0.337	0.472

Table 5.2 presents the types of water sources used among the sample households. As in other developing countries, households in our sample utilize more than one type of water sources for drinking and other purposes. However, the descriptive results presented in Table 5.3 are based on the major source of drinking used by the sample households. The main sources of household drinking water include private stand pipe, public stand pipe, dug-wells, protected and unprotected springs, rivers/lakes and ponds, and rain water. Despite the multiplicity of sources, each household was able to report only one when asked to report the primary water source used by his/her family. For instance, surface water obtained from rivers, lakes and ponds is the major source of drinking water for about 58% of the households in our sample. Access to improved water source remains limited. The proportion of households who own private stand pipe/tab is just below 1%. Moreover, the proportion of households who

get water from a public stand pipe is only about 4%. Interestingly, the type and composition water sources are generally similar across wet and dry seasons.

Table 5.2: Principal sources of drinking water (%)

	Wet season	Dry season
River lake, and pond	57.98	58.14
Dug-well with pump	24.07	23.75
Public stand pipe	4.11	4.31
Unprotected spring	4.11	4.12
Protected spring	3.53	3.74
Dug well without pump	0.00	4.02
Water vender	1.91	0.57
Rain water	1.91	0.10
Water truck	0.67	0.10
Private stand pipe/tap	0.57	0.57
Other	0.19	0.57

Source: EEA/IFPRI Survey Data 2009.

Respondents were asked to report their satisfaction with regard to availability and quality of water the principal source of drinking water. Unfortunately, we do not observe water sources or collect water samples from them to determine water availability and quality outcomes. Our analysis is entirely dependent on respondents' own subjective assessment of the sources they use with regard to the adequacy and quality of water they obtain from them.

Table 5.3 presents descriptive summary of the association between sources of drinking water and households' reported satisfaction. As expected, the descriptive results reveal strong association between the type of drinking water source the households use and their reported satisfaction. In general, households who obtain their drinking water from improved sources are more satisfied with both availability and quality of water. However, Household satisfaction with the availability of water is relatively lower. As expected, households are generally content with water quality and households who obtain their drinking water from an improved source are more satisfied with both water quality and availability than those who fetch it from an unimproved source. The survey result also indicates satisfaction rates are slightly lower in the dry season than in the wet season. These results suggest households' perception of the need for improvement of drinking water services.

Table 5.3: Household satisfaction with drinking water supply by water sources and seasons

Water services	Respondent is satisfied with the water service	Water Source		Pearson chi2 value
		Unimproved	Improved	
Water quality	Wet season			
	Yes	41.99%	90.03%	202.83***
	Dry season			
	Yes	39.01%	90.28%	227.79***
Water Availability	Wet season			
	Yes	77.48%	91.59%	29.05***
	Dry season			
	Yes	65.53%	83.02%	31.85***

***=significant at 1%.
Source: EEA/IFPRI 2009 Survey Data.

We also asked dissatisfied households to report their main reasons for feeling so. Experiences of respondents with respect to water quality show considerable variation across the sample (see Table 5.4). The main causes of dissatisfaction include bad water color, presence of dirt substance and bad smell. Many households also suffered illness from water-borne diseases. It is important to note respondents' opinions regarding water quality problems are quite similar between wet and dry seasons.

Table 5.4: Reasons for dissatisfaction with water quality from the primary source (%)

	Wet season	Dry season
Dirt substance (visible pollution)	54.01	52.61
Bad color	23.54	17.12
Bad odor	7.34	10.02
Bad taste	7.78	8.35
Felt sick after drinking it	7.34	8.14
Other	0.00	3.76

Source: Authors' computation based on EEA/IFPRI 2009 Survey Data.

Respondents were also asked the main reasons for the unavailability of water at their primary water sources. As indicated in Table 5.5, most respondents indicated inadequate water quantity in the sources as the major problem followed by the existence of broken facilities. Similar problems are reported by households for both wet and dry seasons.

Table 5.5: Reasons for non-availability of water at the primary source (%)

	Wet Season	Dry Season
Not enough water in source	81.4	87.4
Facility broken	16.2	10.36
Other	2.3	2.25

Source: Authors' computation based on EEA/IFPRI 2009 Survey Data.

a. Estimation results

Tables 5.6 to 5.8 present the estimation results of our empirical models. The Wald chi2 statistics indicate that the model specifications for our estimations have good explanatory powers. All the models include a host of control variables including socioeconomic, demographic and location in addition to our variable of interest, water source. Table 5.3 indicates univariate probit estimation results of factors influencing use of an improved water source. Whether a household gets its drinking water from an improved water source is related to a host of demographic, socioeconomic and location characteristics. As expected, the variable roof and light have significant and positive influence on the dependent variable. On the other hand education of head of household has a positive and close to significance relationship. In other words, households whose heads can read and write have a 54 percentage point higher probability of getting drinking water from an improved source. Contrary to our anticipation, female headed households have a larger probability of using an improved source. Perhaps, this effect may be due to the following reasons. First, women along with children are the main persons responsible for fetching water and other domestic chores and when they become heads they more interested to invest on clean water supply. Second, as studies elsewhere indicate women are more risk averse than men and hence want to minimize waterborne illnesses by using improved sources of water available to them. Older individuals have a lower probability of obtaining water from an improved source, although this relationship is statistically weak.

As expected, households who use improved latrine are more likely to have an improved water source. Having an improved latrine, for instance, is associated with a 6.7 percentage point higher probability of obtaining drinking water from an improved source.

The estimation results also indicate that location of residence exerts a significant effect on the dependent variable. For instance, keeping all other factors constant, households in Gog have a 16 percentage point higher probability of getting their drinking water from an improved source. In contrast, household in other locations have significantly lower likelihood of getting their drinking water from an improved source.

Table 5.6: Probit estimation of users' choice of improved source of drinking water

Variable	Coefficients	Standard error	Marginal effect
Intercept	-0.327	0.297	
Age	-0.002	0.004	-0.001
Gender	-0.208*	0.128	-0.066
Education	0.178*	0.109	0.055
Adult females	-0.197	0.279	-0.06
Under five children	-0.008	0.117	-0.002
Household size	0.018	0.023	0.006
Radio	-0.026	0.111	-0.008
Ox	0.039	0.113	0.012
Pack animal	-0.126	0.121	-0.038
Light	0.304**	0.131	0.089
Roof	0.619***	0.142	0.211
Latrine	0.209*	0.121	0.066
Number of Observation	1102		
Observed probability	0.284		
Predicted probability (at x bar	0.23		
Pseudo LL	-539.06		
Wald (chi2)	217.17***		

Note: district fixed effects were used in the regression.
*** significant at 1%; ** significant at 5%; * significant at 10%

Table 5.7 presents univariate (single equation) probit and bivariate probit estimates for users' satisfaction on the quality of water. As noted earlier, the equations take into account a host of control variables apart from the water source variable. The estimation result here shows having access to an improved water source significantly increases users' satisfaction with respect to water quality. Put in other terms, a household who gets its drinking water from an improved water source have a sixty percentage point higher probability of being satisfied with regard to water quality. In fact, Table 5.7 also gives evidence that apart from the type of water source, satisfaction is determined by households' socioeconomic and location characteristics. Keeping other factors constant, households with a literate head are more significantly less satisfied with the quality of water they use for drinking. Albeit statistically insignificant, male-headed households are more satisfied with the quality of water they use. Keeping other factors unchanged, satisfaction on the quality of water is significantly larger in Ibantu, Ofla and Sekota and lower in Gog, Shecko and Yaso, as compared to the reference location.

As indicated in Table 5.7, rho has a statistically significant and positive coefficient suggesting the rejection of the hypothesis that the error terms of the two equations are not related. In this regard, our data is more feasible for bivariate probit estimation than for single equation probit model. The main implication here is that unobserved/omitted factors determining the probability of obtaining drinking water from an improved source also determines the likelihood of users satisfaction with respect to the quality of water obtained from the source. The parameter estimates of most of the control variables are largely consistent among the two estimation procedures. However, the effect of the endogenous variable, water source, on satisfaction is lower when estimation is performed by bivariate probit. According to the bivariate probit estimate, obtaining drinking water from an improved water source increases household satisfaction by 25%. In fact, in the univariate probit model the large effect of the water source variable on household satisfaction can in large part be due to the strong positive relationship between the disturbances of the two equations.

Table 5.7: Estimation results of household satisfaction with water quality

Variable	Univariate			Bivariate		
	Coeff.	Std.Error	Marg.eff	Coeff	Std.Error	Marg.eff
Intercept	-0.595*	0.304		-1.105*	0.272	
Age	0.0004	0.004	0.0002	-0.001	0.004	0.00004
Gender	0.085	0.142	0.034	0.165	0.124	-0.001
Education	-0.191	0.122	-0.075	-0.257**	0.111	-0.001
Under five children	-0.034	0.124	-0.013	-0.051	0.113	-0.002
Household size	0.018	0.026	0.007	0.007	0.025	0.001
Radio	0.196*	0.121	0.078	0.174	0.112	0.008
Ox	-0.072	0.121	-0.029	-0.078	0.105	-0.0006
Pack animal	0.016	0.134	0.006	0.074	0.123	-0.002
Latrine	0.004	0.152	0.002	-0.097	0.132	0.005
Roof	0.071	0.145	0.028	-0.137	0.155	0.031
Water source	1.859***	0.146	0.598	2.854***	0.118	0.253
Rho (chi2(1))				-0.923		
Number of Observation		952			952	
Pseudo LL		-442.75			-923.38	
Wald (chi2)		249.08***			860.8***	

Note: district fixed effects were used in all regressions.
Wald test of rho=0: chi2(1)=3.225 Prob >chi2=0.072
*** significant at 1%; ** significant at 5% ; * significant at 10%

In contrast to the satisfaction on quality equation, the bivariate probit model does not yield a statistically significant correlation coefficient for rho, even though the sign of the coefficient remains as expected. This means that a single equation probit model can provide a consistent estimate of the effect of water source on users' satisfaction with availability of water. As expected, an improved water source has a significant and positive contribution to satisfaction of users with respect to water availability. However, its effect on water availability is slightly lower than on water quality.

Table 5.8: Estimation results of household satisfaction with water availability

Variable	Univariate			Bivariate		
	Coeff	Std.Error	Marg.eff	Coeff	Std.Error	Marg.eff
Intercept	0.695**	0.274		1.099***	0.324	
Age	-0.004	0.004	-0.001	-0.003	0.004	0.001
Gender	-0.198	0.131	-0.064	-0.248*	0.131	-0.071
Education	-0.051	0.115	-0.017	0.018	0.119	0.062
Under five children	-0.0004	0.115	-0.0001	-0.003	0.111	-0.011
Household size	-0.01	0.023	-0.003	-0.001	0.023	0.009
Radio	0.182	0.114	0.059	0.178*	0.109	0.015
Ox	-0.057	0.114	-0.019	-0.036	0.109	0.024
Pack animal	-0.142	0.127	-0.048	-0.179	0.121	-0.05
Latrine	-0.201	0.141	-0.068	-0.091	0.151	0.068
Roof	-0.032	0.139	-0.011	0.118	0.165	0.188
Water source	0.812***	0.113	0.24	-0.295	0.751	-0.013
Amhara (Bati)			Ref			ref
Gambella (Gog)	-0.399**	0.198	-0.143	-0.310	0.211	0.018
Oromia (Ibantu)	0.532**	0.215	0.155	-0.043	0.409	-0.339
Tigray (Ofla)	0.681***	0.217	0.186	0.394	0.316	-0.122
Amhara (Sekota)	0.605***	0.193	0.171	0.339	0.281	-0.119
South (Sheko)	0.487**	0.199	0.144	-0.109	0.431	-0.329
Afar (Telalak)	-0.352	0.217	-0.126	-0.656**	0.276	-0.211
Benishangul Gumuz (Yaso)	-0.421**	0.196	-0.152	-0.535***	0.187	-0.124
Rho (chi2(1))				0.61		
Number of Observation		953			953	
Pseudo LL		-520.96			-1002.78	
Wald (chi2)	112.08***			310.09***		

Note: district fixed effects were used in all regressions.
Wald test of rho=0: chi2(1)=1.461 Prob >chi2=0.227
*** significant at 1%; ** significant at 5%; * significant at 10%

6. Conclusions

Increased access to clean water is an integral part of Ethiopia's economic development and poverty reduction policy. Recent official figures indicate increased coverage of clean water coverage in the country. Despite the increased support provided to the sector, there are millions of people still depending on unsafe drinking water sources especially in rural area of the country. Furthermore, coverage rates alone may understate the problem if satisfaction with the water quality and availability remains low among households with improved water source. Indeed, according to a recent survey indicates that improved water infrastructure in rural Ethiopia are not functioning properly due to maintenance problems suggesting that uncertainty regarding water availability remains a persistent challenge in the local population.

Thus, the main purpose of the present paper has been to investigate whether or not improved water sources satisfy their users. The empirical data were collected from a random sample of 1117 rural households residing in seven regions of the country. We applied univariate probit and bivariate probit models to explain the effect of access to an improved water source on users' satisfaction with respect to the quality and availability water. Our regression analyses provide suggestive evidence that it has increased users' satisfaction. However, our analyses also show that existing improved sources do not deliver the required services at their full potential due to frequent technical and non-technical problems.

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DOES ELECTRICITY SUPPLY STRATEGY MATTER? SHORTAGE AND INVESTMENT: REFLECTIONS BASED ON CGE ANALYSIS

Ermias Engeda[1], Eyasu Tsehaye[2] and Seneshaw Tamru[3]

1. Introduction

1.1 Background

Ethiopia has been growing at a staggering average GDP growth rate of 8.6 percent for the past 10 years (MOFED 2010); all the major sectors of the economy have shown a remarkable leap forward. The industry and service sectors have grown on average by 9.1 and 10.7 percent respectively over the period. The share of non-agriculture sector in the GDP is also increasing. In line with this, power consumption in the country especially in the industry sector has been increasing. Household electrification programs, mostly rural, have also contributed to the rise in power consumption.

Despite the fact, the country's power supply hasn't kept pace with demand, both due to technical problems and delayed capacity expansions. Furthermore, as almost all of Ethiopia's electric power supply is from hydropower, shortage of rainfall adds to the problem. Consequently, the country endured a power shortage which has been worsening year after year over the past three years, 2007/08- 2009/10[4].

To manage the problem, government has been taking short and long term measures. As an immediate remedy, the Ethiopian Electric Power Corporation (EEPCo) went for rationing. Rolling blackouts had to be scheduled once or twice a week throughout the country and sometimes every other day depending on intensity of the shortage. Almost all industries that use electric driven machineries lost power in shifts. Some

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[4] The Ethiopian fiscal year begins in July and ends in June.

industries like cement, steel manufacturing and crushers at times lost power completely as the shortage got more serious in early 2009/10. The power shortage therefore has created a situation that strained production process of different activities especially in urban centers. The total effect of this resulted in slowing down the speed of the economic growth.

Power shortage and its implication on an economy is not specific to Ethiopia. Studies on other developing countries show strong adverse effect of power shortage on an economy. According to a study by Ferguson et al (2000), there is a strong correlation between electricity use and economic growth. The Pearson correlation coefficient between growth in annual electricity use and average annual economic growth for Sri Lanka during the period 1971 – 1995 is 0.993. Since energy demand in Sri Lanka is mainly met by hydropower, serious droughts have led to a dramatic decline in its economic growth. Additionally, a CGE analysis on the economy wide impact of electricity shortage on South African economy, by Rob Davies (2008), shows that electricity shortage has a very significant negative effect on the GDP. According to the study, a rationing measure as opposed to a market solution (price adjustment) for the problem caused the GDP to fall by 10.1 percent.

The general objective of this paper is to understand the implications of electricity shortage and increasing electricity generation capacity on the economy. The specific objectives are: to critically evaluate government's strategic thinking about supply rationing as a short-term solution by comparing it with alternative rationing strategies; to demonstrate the economic advantages of increasing electricity generation capacity in the long run, even beyond local needs and export to the region.

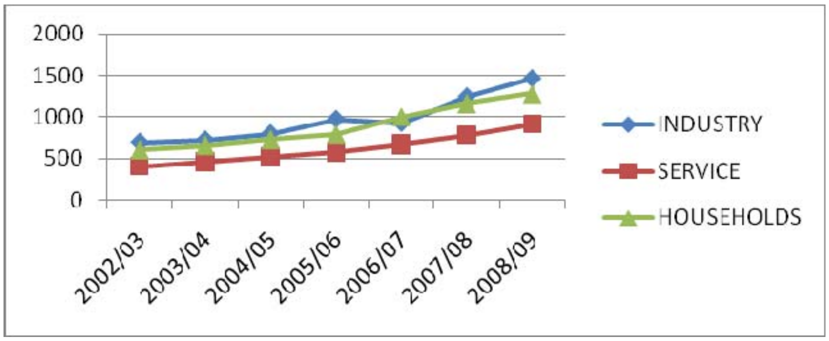
2. Electricity consumption and supply in Ethiopia

Ethiopia has economically exploitable electricity generation potential of more than 45,000 MW from hydro, 5,000 MW from geothermal and 10,000 MW from wind (EEPCo) though only a fraction of this potential has been harnessed so far. The vast majority of its domestic energy need is still fulfilled by wood fuel and animal dung. During 2009/10, only about 41 percent of the population had access to electric energy (MOFED 2010) and even those who had the access couldn't find full service because the country was plagued by power cut.

2.1 Trend in electricity consumption

The Ethiopian economy has grown rapidly in recent years accompanied by increasing consumption for power as an input and a tendency to increase use of electronic household utensils, and rural electrification program of the government. According to data from EEPCo, power consumption has been increasing for all types of users. For the past seven years, industries have been, on average, the number one users of electricity in Ethiopia followed by households.

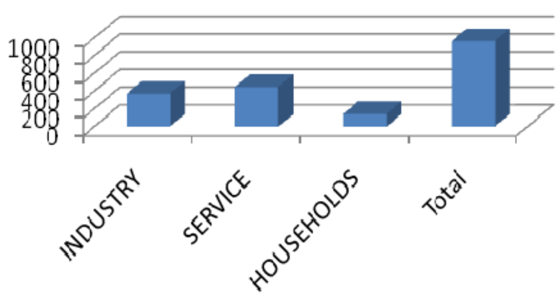
Figure 1: Power consumption trend by all users in Ethiopia (GWH)



Source: Based on data from EEPCo

In the usual trend, EEPCo was expecting power consumption to increase in 2009/10 fiscal year for all types of users. The largest rise was expected from the service sector which is rated as high as 448 GWH. Power consumption of the industry sector and households was expected to rise by 371 GWH and 143 GWH respectively which constitutes an expected total rise in power consumption of about 962 GWH in 2009/10. This makes expected total consumption to be about 4546 GWH in the year.

Figure 2: Expected rise in power consumption (in GWH) from all types of users in 2009/10.



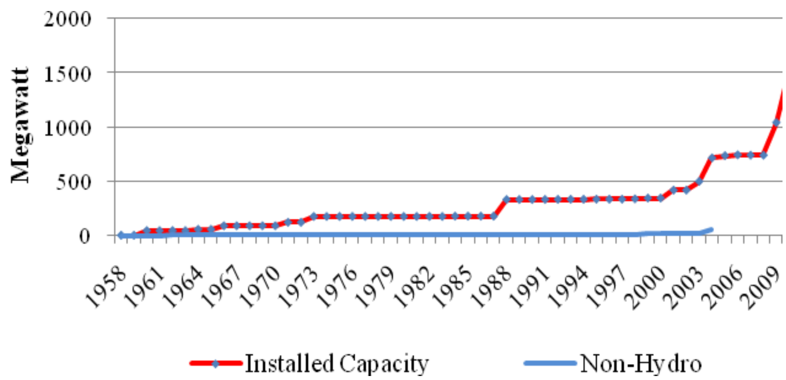
Source: Based on data from EEPCo

2.2 Electricity generation capacity: Supply and shortage

In order to meet the increasing power consumption, the Ethiopian government is recently striving to exploit the huge electricity generation potential of the country.

Even though the country's total installed capacity has almost stagnated for over half-a-century, from 1958/59 to 2002/03, with very slow increment, it has shown a significant rise since 2003/04. In fact, power generation capacity during 2009/10 has increased by more than it did in half a century time.

Figure 3: Electricity generation capacity from 1958 to 2010 in Ethiopia

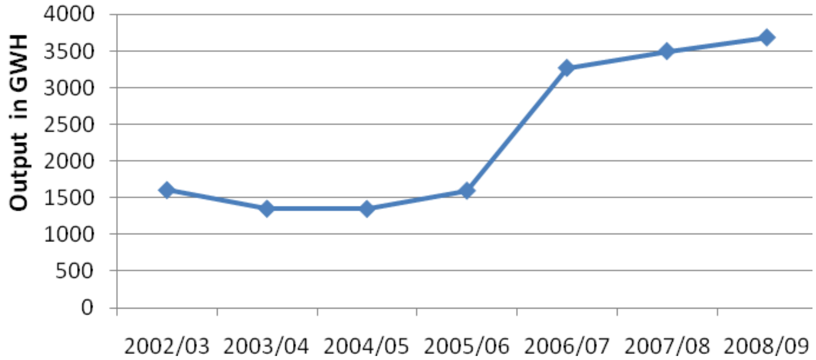


Source: Based on data from EEPCo

Three hydropower plants (Gilgel Gibe II, Tana Beles, and Tekeze I) with a combined capacity of 1.18 GW were completed in 2009/10 alone, more than doubling the previous installed capacity of the country. Gilgel Gibe II, which doesn't have its own dam, has an installed capacity of 420 MW, Tana Beles has 460 MW, and Tekeze I 300MW (EEPCo, 2010).

Unlike the increase in installed capacity, actual electricity production has stagnated between 2002/03 and 2005/06. Production however considerably increased between 2005/06 and 2008/09. It reached 3684 GWH in 2008/09 from its level of merely 1606 GWH in 2002/03.

Figure 4: Yearly actual electric production trend



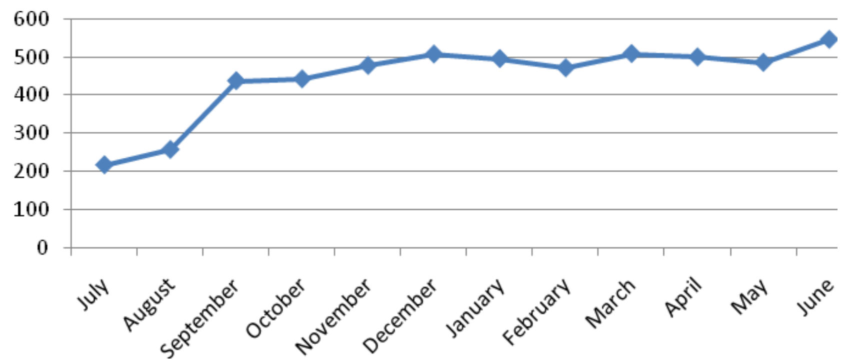
Source: Based on data from EEPCo

In line with this, EEPCO was expecting to produce some 5,272 GWH from the old and newly inaugurated plants in 2009/10. That is 2811 GWH from the old dams, 1929 GWH from the new dams, and the remaining 532 GWH from government owned and rented diesel generators.

The expansion of electric coverage in the country as well as the increasing demand from the growing industry and service sectors has created unprecedented electricity demand that exceeded the available electricity generation capacity in the last three-four years. Despite the fact that there is a tremendous rise in installed electricity generation capacity in the past couple of years, the country has recently faced a chronic power shortage. As is mentioned above, it was serious during 2007/08 and 2008/09 and even more serious in 2009/10.

There are different dimensions to the electricity problem faced by Ethiopia in 2009/10. While they are related, they have different prime causes and may require different responses. According to EEPCo's expectation, during the early two months of the fiscal year, July and August, total electricity output would be the lowest from the other months of the fiscal year. This was because of shortage of rainfall during the *Belg* (minor season) which affects the power generation capacity as the dams had not enough water stored that can be used to generate any more amount until the next rainy season.

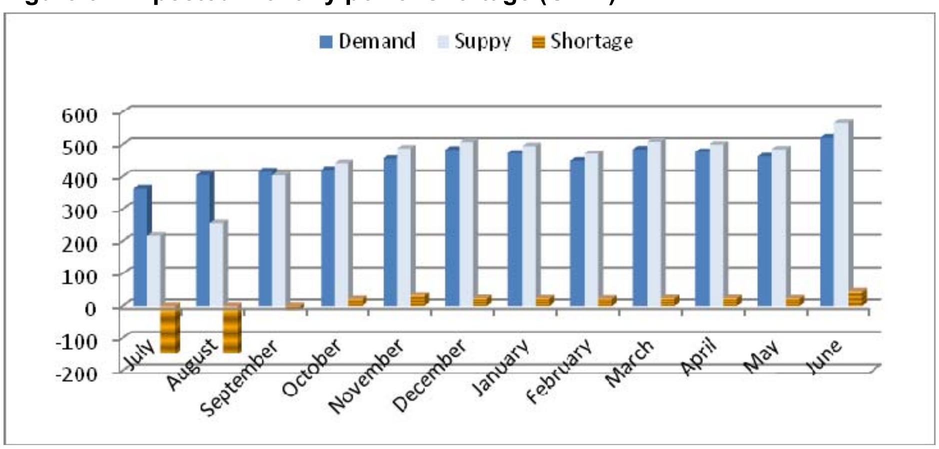
Figure 5: Expected monthly electric production (in GWH) in 2009/10



Source: Based on data from EEPCo

Based on the expected electricity output and consumption, EEPCo expected power shortage for the first three months of 2009/10 only, of which the first two months were expected to be affected the most. The shortage was quantified to be about 149 GWH during July and August and about 13 GWH during September.

Figure 6: Expected monthly power shortage (GWH)



Source: Based on data from EEPCo

However, the shortage went beyond the two months because of the delay in completion of the dams and the failure to realize the newly inaugurated Gilgel Gibe II's production due to the technical problem it faced after very short time in use. Gilgel Gibe II was expected to produce the largest electricity output (1135 GWH) in 2009/10.

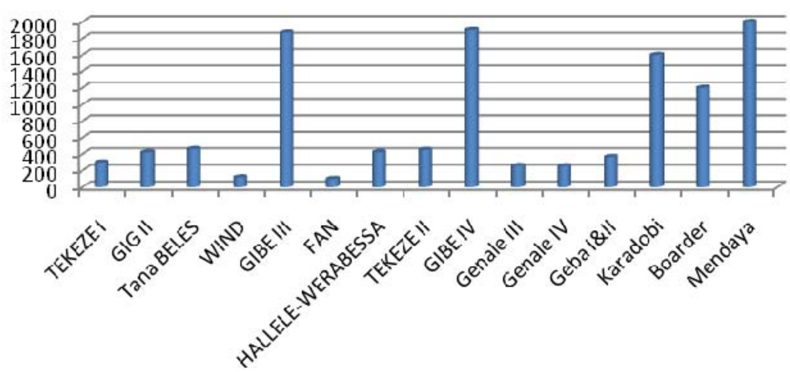
As a result of its failure, the power shortage was further aggravated until the inauguration of Tana Beles in May 2009/10 which slightly eased the problem.

2.3 Government's measures to mitigate the power shortage

Short term: As an immediate remedy to the power shortage, EEPCo started rationing, though the sectors were not treated equally. The rationing varied from time to time and from sector to sector depending on the intensity of the power shortage and EEPCo's favoring and disfavoring of activities. As the shortage got more serious in 2009/10 some industries like cement, steel and crushers were completely cut off; some were allowed to work limited hours while some industries that are believed to be 'key' (export oriented sectors) were given special privilege in power use. In the same intensity as the service sector, households, users of about 34 percent of the power supply, were also part of the rationing.

Long term: In order to get rid of the power shortage problem once and for all, and in an effort to significantly increase access and also speed up its development endeavor, the government has embarked on an ambitious dam building program. In addition to the three already completed hydro electric generation plants in 2009/10, Gilgel Gibe III hydro power plant is under construction with an installed capacity of 1.87 GW.

Figure 7: Power generation capacity of the new plants and projects (MW)



Source: Based on data from EEPCo

Contracts for four more large dams have also been signed and their construction has already started. In addition, there are eight more new power generation plants under project study stage. All the projects are expected to commence production within the coming five to ten years. Once completed, these dams would increase the total power generation capacity of the country by 10.5 GW from less than 1 GW in 2008 (EEPCo, 2010). Given this, the ever increasing domestic demand is expected to be fully satisfied and the excess to be exported to neighboring countries of Sudan, Kenya, Djibouti and even Yemen.

3. The model and simulations

Computable general equilibrium (CGE) models are simulations that combine the abstract Walrasian general equilibrium model with realistic economic data to solve numerically for the levels of supply, demand and price that support equilibrium across a specified set of markets (Shoven and Whalley, 1984). A CGE model captures the detailed accounts of the circular flows of receipts and outlays in an economy. In addition, it satisfies the equilibrium conditions for all markets simultaneously and is thus useful in analyzing associations between various agents of the economy.

3.1 Model and data

This study uses IFPRI's standard static CGE model[5]. The model is formulated as a set of simultaneous linear and non-linear equations, which define the behavior of economic agents, as well as the economic environment in which these agents operate. This environment is described by market equilibrium conditions and macroeconomic balances.

In the model a multi-stage production technology is adopted. At the top level, value added and intermediate inputs are combined via a Constant Elasticity of Substitution (CES) production technology to produce gross output. Factors of production (value added) are governed, in the model, by a constant elasticity of substitution (CES) function and producers respond to changes in relative prices and are able to substitute between factors of production subject to constant returns to scale motivated by profit maximization. The intermediate inputs are aggregated in a fixed-share proportion as in Leontief specification.

The substitution between domestically sold and exported commodities is undertaken based on constant elasticity of transformation (CET) function with an assumption of imperfect transformability between these two destinations. By doing so, the specification captures any time or quality differences between the two products.

[5] For detail of the model see Lofgren, H., Harris, R. and Robinson, S. (2001)

Similarly, the total commodity supply in the domestic market is a composite of the domestically produced and imported. This is captured by Constant Elasticity of Substitution (CES) aggregation function, imperfect substitutability between imports and domestic output sold domestically as specified in Armington function (Armington, 1969).

Households consumption demand is given by a linear expenditure system (LES), derived from a Cobb-Douglas utility function. The model assumes that households maximize utility subject to budget constraints. Households finance their consumption demand from their income.

The model relies on the 2005/06 Ethiopian Social Accounting Matrix (SAM). The SAM is comprehensive and has economy-wide data framework typically representing the economy of the country. The national SAM is disaggregated in 47 activities, 69 commodities, 10 factors, and 8 institutions including 6 households. The SAM also has different taxes, saving-investment, inventory and rest of the world accounts to show the interaction of different economic blocks.

3.2 System constraints and macro-economic closures

In order for the model to show systematic workings of a given economy, important system constraints and macro-economic closures need to be set. Accordingly, equilibrium in the goods market requires that demand for commodities equals supply, which is attained through the endogenous interaction of domestic and foreign prices, and the effect that shifts in relative prices have on sectoral production and employment, and hence institutional incomes and demand.

On the other hand, factor demand and supply depend on how the relationship between factor supply and wages is defined. Capital is assumed to be fully employed and sector-specific which implies sector-specific wages adjust to ensure that demand for capital equals total supply. Labor is assumed to be unemployed and mobile across sectors implying a fixed wage rate.

Similarly, in order to capture the behavior of investors, the government, and the rest of the world, three macro-economic balances or closures for government account balance, current account balance, and savings-investment balance are included in the model. Each closure has differing options and underlining alternative assumptions that represent the way institutions operate in the economy and can substantively influence the results of the model. The options under these closures are chosen based on their appropriateness to the Ethiopian context.

For saving-investment (S-I) behavior, savings-driven investment closure (instead of investment-driven savings closure) is adopted. Under this closure the savings rates of domestic institutions are fixed, and investment adjusts endogenously to the availability of loanable funds to ensure that savings equals investment spending in equilibrium. The closure option chosen better depicts the country's current consumption, savings and investment behavior.

Consistent with the fact that direct tax rates have been pretty much unchanged over the past years in Ethiopia, among the government closure options, the one with fixed tax rates and flexible government savings is chosen. This implies the government has to borrow in order to finance its deficit and is constrained in raising taxes to cover additional public spending.

For the current account balance, as Ethiopia adopts a managed-floating exchange rate scheme, it can be assumed that the level of foreign savings is fixed and exchange rate is flexible. This implies that during shortage of foreign savings, the real exchange rate adjusts simultaneously by depreciating the Birr with respect to USD to reduce spending on imports and increase earnings from export in order to maintain a fixed level of foreign borrowing.

In addition, the domestic producers' price index is chosen as the numéraire and hence all prices in the model are relative to the weighted unit price of producers' initial production bundle.

3.3 The simulations

3.3.1 Electricity shortage simulation

The impact of the electricity shortage on the economy is simulated in a general equilibrium model by introducing productivity loss in each activity as exogenous shock. The efficiency parameter (α^{va}_a) of the production function (equation 1) is used to translate the direct productivity loss into the model.

$$QVA_a = \alpha_a^{va} * \left(\sum_{f\epsilon F} \delta_{f,a}^{va} * QF_{f,a}^{-\rho_a^{va}}\right)^{1/\rho_a^{va}} \text{............................} \quad (1)$$

where

QVA_a = *quantity of (aggregate) value-added*

α^{va}_a= *efficiency parameter in the CES activity function*

δ^{va}_{fa} = *CES activity function share parameter, and*

ρ^{va}_a = *CES activity function exponent*

$QF_{f,a}$ = *Quantity of factor f used in activity a*

The productivity losses due to the shortage were estimated separately. In estimating the productivity loss of a firm, three factors have been considered: (1) duration of the electricity shortage (ES), (2) the intensity of electricity usage (share of a firm's electricity input per unit of output), and (3) substitutability factor (***α***). Substitutability factor is the firms' ability to use alternative energy source or the ability to undertake its major production process without power. This factor is considered because there may be instances where a firm may use little electricity per output but still highly depend on electricity.

Given this, the percentage decline in output (productivity loss) for an activity is estimated as:

$$PL = ES * IL \qquad (2)$$

Where ***PL*** = *Percentage decline in output (productivity loss)*
ES = *Duration of Electricity Shortage (%)*
IL = *Impact level*

Where the impact level of electricity shortage on an activity is estimated as:

$$IL = \left(Q_{\alpha,elect} / Output \right)^{1/\alpha} \qquad (3)$$

Where ***IL*** = *Impact level*
$Q_{a,\,elect}$ = *Value of electricity intermediate input*
Output = *Value of Output*
α = *Substitutability factor*

The duration of the electricity shortage is estimated for 2009/10[6] based on the actual rationing schedule of EEPCo. EEPCo had used different rationing programs at different times based on the level of shortage. In early 2009/10 (July and August) the electricity shortage was severe and rolling blackouts were scheduled every other day throughout the country. During this time, many industries including cement and steel manufacturing were completely cut off from electricity supply. The shortage was less sever in the middle and late 2009/10 and rolling black outs were less frequent. Throughout the year EEPCo implemented different monthly rationing plans that reflected the intensity of the shortage.

[6] 2009/10 is selected as it was the worst hit year of the periods of electricity shortage

During the rationing, some export oriented industries including leather and textile manufacturing were given special privilege for electricity use. Given the selective favoring and disfavoring, estimating the overall shortage of electricity by industries in 2009/10 requires aggregating the different actual rationing schedules of EEPCo in the fiscal year. During the aggregation of electricity shortage for different types of users, the users' weights in terms of electricity consumption were taken into account for averaging the overall shortage. Accordingly, the average electricity shortage for 2009/10 was estimated to be 12.9 percent of the time in the year.

Since the rationing schedule was not uniform across different users, the electricity shortage faced by different industries also varies. For example because the mining and quarrying activities were disproportionately disfavored during the electricity rationing, the actual electricity shortage endured by these activities is 37.5 percent of the time. On the other hand, the actual shortage of electricity faced by other industries which were favored in the rationing program were below the average shortage of 12.9 percent of the time. For industries such as leather manufacturing which had special privilege in electricity use at all times, electricity shortage level was zero percent.

The second factor considered in the estimation of productivity loss, intensity of electricity usage, is taken from the 2006 Social Accounting Matrix (SAM) of Ethiopia. Looking at activity level demand, according to the SAM, such activities as agriculture, fetching water and real estate do not use electricity as intermediate input. All the other activities use electricity with different levels of intensity in relation to their outputs. Industries generally use higher values of electricity than services per unit of output. Among the activities in the industry sector, construction and manufacturing of electrical equipments have the highest output per electricity input while Mining and quarrying and manufacturing of mineral products (Mineral products manufacturing) have the least output per unit of electricity input (see Table 1).

Different rationing alternatives under the existing power supply constraint were tested and analyzed in a general equilibrium.

Given the total average of 12.9 percent electricity shortage during 2009/10, different rationing scenarios, favoring and disfavoring selected activities, can be compared based on different criteria of interest. Accordingly, in this study, the government's rationing strategy is simulated and compared with three other deemed important and practical alternative strategies. With a fixed electricity supply in the year, favoring a particular industry in any of the rationing alternatives entails disfavoring another industry.

Table 1: Electivity use and electricity productivity in different activities of the industry sector

Activity	Electricity use (000 Birr)	Electricity productivity Output/Input	Activity	Electricity use (000 Birr)	Electricity productivity Output/Input
Grain mill production	13,272.4	49.4	Electrical Equipment manufacturing	55.1	1,981.4
Other food manufacturing	37,075.9	72.3	Textile manufacturing	37,043.7	36.5
Beverage manufacturing	17,648.1	103.8	Leather manufacturing	11,315.9	94.5
Sugar manufacturing	5,383.2	214.9	Wearing apparel	1,425.2	248.2
Tobacco manufacturing	769.2	280.7	Vehicle manufacturing	1,202.3	342.0
Paper products manufacturing	12,694.9	55.0	Wood manufacturing	1,926.7	55.9
Mineral products manufacturing	58,749.0	19.9	Other manufacturing	3,691.2	425.6
Basic metal manufacturing	12,916.0	154.4	Mining & Quarrying	37,876.4	19.3
Chemicals manufacturing	26,228.7	61.1	Construction	7,270.0	2,922.2
Machinery & Equipment manufacturing	94.7	236.5			

Source: Calculated from 2005/06 EDRI SAM

Scenario 1: Rationing that favors export sectors and disfavors selected sectors (GOVRAT)

This rationing alternative is similar to the way government distributed the power shading. The actual rationing for the year can be summarized as:

- Exempting textile and leather manufacturing from the power shading;
- 37.5% power shading in the mining & quarrying activities ;
- 31.8% power shading in basic metal manufacturing ;
- 19.3 % power shading in mineral products and chemical manufacturing ; and
- 11.2 % power shading in all the remaining activities.

Scenario 2: Uniform Rationing (UNIRAT)

Another option considered for accommodating electricity power shortage is to ration all economic sectors equally without any favor or disfavor. This alternative is equivalent to electricity shading for 12.9 percent of the time in all activities which is the weighted average shortage as discussed above.

Scenario 3: Rationing that favors export sectors (EXPRAT)

This alternative favors export oriented activities in the same way as the government rationing strategy, but uniformly disfavors the rest of the activities. This is equivalent to:

- Full electricity supply to textile and leather industries; and
- 13.5% electricity shading in all the other activities.

Scenario 4: Rationing that favors activities of high electricity productivity (PRODRAT).

The other alternative to reduce output loss due to electricity shortage is to favor activities with high electricity productivity and disfavor activities with relatively low electricity productivity. In doing this, industrial activities are categorized into three levels of electricity productivity: high, medium and low. High electricity productivity activities are favored, low electricity productivity activities are disfavored and medium electricity productivity activities are moderately rationed. In this alternative, in addition to rationing based on electricity productivity, export oriented activities are also favored. This alternative is equivalent to:

- 100% electricity supply to textile and leather manufacturing;
- 100% electricity supply to activities whose output per unit of electricity is relatively high including electrical equipments manufacturing, vehicles, tobacco, wearing apparel etc.
- 15.6 % power shading on activities whose output per unit of electricity is relatively low. These activities include mining & quarrying, flour manufacturing, paper products, chemicals, wood manufacturing, etc.
- Average (12.9 percent) power shading in all the remaining activities with medium level of electricity productivity.

3.3.2 Electricity investment simulation

Under this simulation, the country's current step in increasing electricity power generation, the intent to export, and increment in domestic electricity consumption is simulated. The output rise is estimated for the investments already made since 2006 and investments planned to be undertaken until 2015. As the analysis is based on a static CGE model, the investment during the 9 years is calibrated in the model as if it occurs in a single period.

To simulate electricity investment, return on capital of the electricity activity was used as a main instrument to bring about increased level of electricity production. The increased production is in line with the most recent government's plan to increase production, domestic consumption, and export.

On the other hand, to have increased level of rural households' electricity consumption, the households' autonomous consumption parameter of the consumption function is used as an instrument. This parameter is selected to affect households' electricity consumption to be consistent with fixed pricing of the commodity.

4. Results and discussion

4.1 Electricity rationing

The simulation result shows that the power shortage during 2009/10 has affected the economy significantly. The overall output loss based on government's actual rationing scheme is estimated to be around 3 percent of GDP. The effect of the shortage is negative in all activities, manufacturing being the most affected with an output loss of 10.3 percent. On the other hand, service and agriculture sectors are relatively less affected, with output loss of 2.3 and 2.7 percent respectively.

The larger percentage loss of output in manufacturing is due to the higher importance of electricity input in the sector. The output loss in activities that are directly affected by the shortage has also resulted in an indirect output loss in other activities through forward and backward linkages. The output loss in agricultural activities for example is purely an indirect impact because agriculture does not rely on electricity input in its production.

Table 2: Output loss by activity based on EEPCo's actual electricity rationing

Value Added (Billion Birr)	Base	Electricity shortage	% change
Agriculture	58.8	57.2	-2.7
Industry	14.1	13.0	-7.7
Manufacturing	5.8	5.2	-10.3
Services	49.4	48.3	-2.3
Total GDP	122.2	118.5	-3.06

Source: Simulation Result

The impact of the electricity shortage on external trade, domestic investment expenditure, and output by major activities under alternative rationing strategies are presented on Table 3 and 4. The details of output loss by activity are also presented in annex 1. Based on the result, the impact of the shortage on output, external trade and investment is slightly different under different rationing alternatives. In every consideration of the table below, government's rationing scheme (GOVRAT) is slightly worse than all the other alternatives. Despite government's measure in favoring export oriented activities, total export fell the most under this alternative. This shows that favoring a particular industry alone with less regard to the activities that are closely linked to the industry may not bring intended results. The GDP loss in the actual government rationing scheme was also the largest (3.06 percent) among the alternatives. The high GDP loss was the result of the disproportionate disfavoring of selected activities that brought about big direct output loss with significant negative spillover in other activities.

Table 3: Results under different alternative scenarios (percentage changes)

	BASE (billion Birr)	GOVRAT	UNIRAT	EXPRAT	PRODRAT
GDP at Constant Prices	122.22	-3.06	-2.73	-2.71	-2.71
EXPORTS	16.80	-5.49	-5.42	-5.39	-5.28
IMPORTS	-47.00	-1.96	-1.93	-1.92	-1.88
INVESTMENT	28.20	-4.10	-3.50	-3.60	-3.60

Source: Simulation Result

Since manufacturing industries except textile and leather are severely disfavored in the government rationing scheme, the output loss in manufacturing under GOVRAT is the highest among all alternatives. In terms of total output loss, uniform power rationing across all activities (UNIRAT) would have reduced the output loss to 2.73 percent of GDP. The decline in investment expenditure is also the least under uniform rationing. On the other hand, favoring export oriented activities while uniformly distributing the shortage in all the remaining activities (EXPRAT) further reduced the GDP loss to 2.71 percent. The export decline in this alternative is also smaller than GOVRAT and UNIRAT. The lower output loss under EXPRAT compared to UNIRAT is due to the stronger linkages of the textile and leather industries to the rest of the economy that induce stronger output effect.

Table 4: Output loss by major activity under different rationing alternatives (% changes)

	BASE (bill. Birr)	GOVRAT	UNIRAT	EXPRAT	PRODRAT
Agriculture	58.8	-2.70	-2.40	-2.36	-2.38
Industry	14.1	-7.38	-6.07	-5.98	-6.06
Manufacturing	5.8	-9.90	-9.20	-8.76	-8.67
Services	49.4	-2.26	-2.17	-2.21	-2.15
Total GDP	122.2	-3.06	-2.73	-2.71	-2.71

Source: Simulation Result

Favoring the export sector and activities with high electricity productivity simultaneously (PRODRAT) would have also reduced the negative impact of the electricity shortage in the economy, to 2.71 percent, as in EXPRAT. The export decline in this alternative is smaller than all the other alternatives.

The welfare impact in terms of household consumption also slightly varies among the different rationing alternatives. Overall household consumption declined by 2.41 percent under government's actual rationing scheme (GOVRAT) which is the highest decline of all the alternatives. In this rationing scheme, the declines in consumption in almost all household types are the highest. On the other hand, favoring export oriented activities (EXPRAT) or export oriented activities together with high electricity productive activities (PRODRAT) would result in the least household consumption loss. The reduction of household consumption is largely related with the decline in GDP. The household consumption reduction under GOVRAT for example is the highest among the other alternatives because the GDP loss under this alternative is also the highest.

Table 5: Consumption by households under different rationing alternatives (% changes)

	BASE	GOVRAT	UNIRAT	EXPRAT	PRODRAT
rural poor	19.1	-2.12	-1.92	-1.91	-1.92
rural non-poor	59.4	-2.66	-2.38	-2.34	-2.33
urban poor	3.9	-1.85	-1.92	-1.84	-1.87
urban non-poor	21.5	-2.10	-1.96	-1.92	-1.92
Total household	103.8	-2.41	-2.19	-2.15	-2.15

Source: Simulation Result

Generally, favoring the export sector and activities with high electricity productivity simultaneously (PRODRAT) is the best alternative in all considerations except in domestic investment expenditure where uniform rationing had the least investment reduction.

4.2 Investment on electricity

The investment simulation on electricity and the associated electricity export shows that the government's investment will have a significant growth contribution to the economy with GDP increment of about 6.1 percent.

The estimated GDP growth is expected to come mainly from the output growth in the electricity activity which is expected to grow by more than eight fold. The investment, however, has a negative effect on the other activities with an output loss of between 0.1 percent in the service sector and 3 percent in agriculture and manufacturing.

Table 6: GDP by major activities under electricity investment

GDP by sector	BASE (2005/06) (Billion Birr)	Investment on Electricity (Billion Birr) Scenario	% Change
Agriculture	58.78	56.97	-3.1
Industry	14.05	23.32	66.0
Electricity	1.12	9.72	765.1
Manufacturing	5.77	5.60	-2.9
Services	49.39	49.35	-0.1
Total	122.22	129.64	6.1

Source: Simulation Result

The decline in agricultural output and export is the result of the induced real exchange rate appreciation which reduced the competitiveness of the country's current export commodities in which agricultural products constitute a significant share. Manufacturing output would also decline as a result of the real exchange rate appreciation. As the share of manufacturing export from the total is very small, the output decline in the activity is supposed to come from the sector's loss in competitiveness in the domestic market. Imported manufacturing commodities would become cheaper and adversely affect production of competing local manufacturing products. This Dutch disease effect is expected to come from export earnings from electricity that bring about a 14 percent appreciation of the real exchange rate. Export of services is also expected to decline significantly even though the rate of decline is smaller than agricultural and manufacturing exports.

The decline in agricultural, manufacturing and service output and the rise in electricity production would bring a significant change in output structure. Electricity would take about 7.5 percent of the country's GDP (from its previous level of only 0.9 percent) while the share of agriculture, manufacturing and services would decline.

Export earnings from electricity after the investment are estimated at Birr 9.6 billion, which would be about 46 percent of total export of goods and services. This would increase total export earnings by 43.2 percent. Since export earnings from electricity significantly increases while exports of other goods decline, the share of electricity exports from total merchandize exports is expected to shoot up to 64.9 percent. Electricity, becoming the first major export earner, is expected to bring a significant shift in export structure of the country. Furthermore, as a result of the relative abundance of foreign exchange and the associated appreciation of the real exchange rate, imports are also expected to rise by 37.6 percent.

Table 7: Export earnings from major activities

	Export in Billion Birr		% change
	BASE	**Investment in electricity**	
Agricultural	5.6	3.5	-37.1
Manufacturing	2.4	1.7	-28.2
Services	6.8	6.2	-8.4
Electricity	0.0	9.6	
Total Exports	14.7	21.0	43.2
IMPORTS	-47.0	-64.7	37.6

Source: Simulation Result

5. Summary and conclusion

Using a static CGE model and based on the 2005/06 Ethiopian SAM, the study evaluated the economy wide impact of electricity shortage on the economy during 2009/10 and compared government's rationing scheme with three competing alternative rationing scenarios. The study also assessed the effect of government's investment on expansion of electricity generation for domestic consumption and export.

The result shows that the electricity shortage in Ethiopia has brought a significant adverse effect on the economy with output loss of 3.1 percent of GDP during 2009/10. The impact was negative in all activities. Though the impact was higher in activities that use higher volume of electricity, activities that do not use electricity have also been affected through the linkages with other activities.

Different rationing alternatives had different impacts. As is evidenced by the other rationing alternatives, government's decision to exempt the export sector from power shading had a positive impact in the economy in terms of reduced output loss. The disproportionate disfavoring of few activities by government, however, has resulted in larger output loss than the other rationing alternatives. Overall, favoring the export sector together with high electricity productivity sectors would have brought better result in terms of reduced output loss and exports.

On the other hand, the simulation on investment in electricity and export shows that the government's investment plan will bring a 6.1 percent rise in GDP. The output growth is expected to come from the electricity activity. The investment however would result in output reduction in all the other activities due to the induced real exchange rate appreciation.

Electricity export would increase total export earnings by 43.2 percent. With the decline in the exports of mainly agricultural and manufacturing commodities, the investment would bring about a significant shift in export structure, electricity becoming the first major export item.

However, as the static version may not capture the inter-temporal economic linkages and transformations of the investment simulation, further study should be undertaken with dynamic CGE model.

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Annex 1. Output by activity (billion Birr) under different electricity rationing alternatives

ACTIVITY	BASE	GOVRAT	UNIRAT	EXPRAT	PRODRAT
Teff	4.45	4.33	4.36	4.36	4.36
Maize & wheat	8.09	7.83	7.87	7.87	7.86
Non-traded agriculture	18.36	17.80	17.87	17.87	17.87
Export crops	10.29	10.04	10.03	10.02	10.03
Livestock	17.60	17.20	17.24	17.27	17.26
Mining & quarrying	0.67	0.49	0.60	0.60	0.59
Other food manuf.	0.69	0.64	0.63	0.64	0.64
Dairy manuf.	0.04	0.04	0.04	0.04	0.04
Grain mills	0.17	0.15	0.15	0.15	0.15
Flour manuf.	0.51	0.46	0.45	0.45	0.44
Sugar manuf.	0.54	0.49	0.49	0.48	0.49
Beverage manuf.	0.84	0.78	0.78	0.77	0.77
Tobacco manuf.	0.12	0.12	0.12	0.11	0.12
Textile manuf.	0.66	0.61	0.60	0.61	0.61
Wearing apparel manuf.	0.18	0.17	0.17	0.17	0.17
Leather manuf.	0.27	0.27	0.25	0.27	0.27
Wood & furniture manuf.	0.07	0.06	0.06	0.06	0.06
Paper & printing manuf.	0.21	0.19	0.19	0.19	0.18
Chemical manuf.	0.37	0.30	0.33	0.32	0.32
Mineral prod. Manuf	0.26	0.22	0.24	0.24	0.24
Basic metal manuf	0.51	0.39	0.46	0.46	0.46
Machinery manuf.	0.01	0.01	0.01	0.01	0.01
Electrical equip. Manuf.	0.01	0.01	0.01	0.01	0.01
Vehicle manuf.	0.09	0.09	0.09	0.09	0.09
Other manufacturing	0.21	0.20	0.20	0.20	0.21
Electricity	1.12	1.11	1.11	1.11	1.11
Water	1.17	1.10	1.10	1.09	1.09
Construction	5.32	5.12	5.15	5.14	5.14
Trade	13.82	13.27	13.33	13.33	13.34
Hotels	2.53	2.38	2.37	2.37	2.37
Transport & comm.	6.35	6.26	6.25	6.24	6.25
Financial services	2.29	2.12	2.11	2.10	2.11
Real estate	9.66	9.65	9.65	9.65	9.65
Public administration	5.96	5.95	5.95	5.95	5.95
Education	4.29	4.26	4.26	4.26	4.26
Health	1.06	1.04	1.04	1.04	1.04
Other services	3.43	3.35	3.36	3.36	3.36
GDP	122.22	118.49	118.89	118.90	118.91

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