IMPACTS OF WATER SUPPLY AND SANITATION ON POVERTY IN ETHIOPIA TO MEET MDGS POVERTY REDUCTION GOAL

[a]Teshome Adugna
[a]Institute of Public Management and Development Studies
Ethiopia Civil Service College, Addis Ababa, Ethiopia.
[a]Corresponding Author: teshomea2002@yahoo.com

 ISSN 1923-6654 (print)
ISSN 1923-6662 (online). Available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

Abstract: Ethiopia's water supply and sanitation coverage is one of the lowest in Africa. Such a situation made people in the country to spend much more time collecting drinking water. In addition to this people have been becoming unhealthy due to the spread of water related diseases. The lack of water supply and sanitation is considered as one factor for the deep and wide spread of poverty in the country. This study investigated the impacts of water supply and sanitation on the poverty incidence through improving the health status of people and increasing crop production. The secondary data, mainly from CSA, MOWR and MOFED used to analyse water supply and sanitation situation in the country and even to estimate the impact of water supply and sanitation in poverty incidence. The study used panel data which were collected from different locations over selected years. The log-log model was specified to get the elasticity of poverty incidence due to the change in the water supply and sanitation. The Fixed Effect Instrumental Variable (FE-IV) estimator was used to estimate the equation.

Under the new water supply and sanitation program (2006-2012) a total of 58 million people would get water supply at the end of the 2012. In addition to this a total of 75.5 million people would get basic sanitation service during the same period. In the rural areas a total of 149,023 new water supply and 15,893,313 sanitation infrastructure would be constructed during the plan period. Similarly in the urban areas a total of 1,335 new constructions would be undertaken in the same period. The efforts to reach the universal access program would reduce the incidence of poverty by 23 million by improving the health status of 7 million people and increasing the total crop production by 26 million quintals. But Absence of consistent development plan, lack of appropriate technology, poor cost recovery and lack of fund, poor coordination and experience sharing practices, lack of private sector and absence of micro-enterprise would be the major challenges to realize UAP target in Ethiopia.

***Keywords*:** Millennium Development Goals, Poverty, Water Supply and Sanitation

1 Introduction

Expanded water resource infrastructure and better water resource management are urgently needed in order to reduce poverty in Ethiopia. Despite the deep rooted problems prevails in the country; a remarkable progress has been made in the Water Supply and Sanitation(WSS) sector during the last few years. These progress can be explained in terms of introducing new WSS policy, setting up the new water supply institution to reach the very poor people, allocating the available financial and material resource to boost the sector financial and material capacity, improving the coordination work in the provision of WSS activities and allowing the private sector to involve in the different activates in the sector.

Such move has been showing practical improvement in the WSS coverage over all the country at rural and urban level in the recent years. In addition to these changes, the prospect of WSS is promising in the future when one observes the government efforts and commitments for changing the sector. In this regard, the ambitious Universal Access Program (UAP) [1], which has been prepared in 2005 to provide WSS to 98 percent and 100 percent of the people in the rural and urban areas respectively, is an indicator of government commitment in the sub sector. This is an evidence to know the future prospect of the WSS sector despite the unexpected challenges that may encounter the implementation processes during the years ahead of us.

Whatever the case, the final gain of the provision of WSS is to improve the living standard of the people by reducing the poverty prevalence in the country. Sustainable improvement in drinking water and sanitation condition is essential to the poor to (1) reduce income losses due to excessive time spent collecting water; (2) increase income earning potential through increase in the productivity; (3) reduce the cost of health services especially for water related disease such as diarrhea; (4) increase income from cattle that depend on water; (5) increase the quality of life of the poor through positive impact on material and child health, improvement in education enrolment and attendance through better school sanitation, reduce home duties for water collection or caring for siblings, especially for girls and reduce drudgery and time spent on collection of water, especially for women [2]

This study will analyse the impact of WSS on poverty through the improvement of health status and total crop production, which would bring an economic growth at the national level. It is difficult to put the term poverty in one single word (term) due to its broad and multidimensional nature. Poverty refers to the life of people below certain standard (poverty line). The provision of enough water supply and basic sanitation strongly protect people from falling below certain level of income by saving their health related expenditure in addition to providing additional time to generate income at the household level. In addition to this the healthier people can work more efficiently than unhealthy people that can increase their productivity which improves the individual income of the people. Such situation clearly enables the people, especially the rural destitute people, which are 85 percent of the people, to work with their full capacity despite sending their children to school for improvement of their future life.

This paper consists of seven sections including introduction. In the second section, I will present the source of data and method for data analysis. In this section one can observe the explanation of variables that included in the analysis. In the third and fourth sections the impact of WSS on the health status and total crop production are analysed based on the availability of data in the country. These sections test the hypotheses which say that WSS significantly improves health status of the people and total crop production in the country. In the next section, the study analyses the impact of the improved health status and crop production on the poverty incidence in the country. The following section dwells on the benefit cost ratio analysis of WSS provision during the UAP in order to see the return of the provision of WSS in the country. The last section summarise the chapter and forward possible recommendation to enhance the provision of WSS in the country.

2. Type of data, model specification and method of data analysis

The study uses the secondary data collected from Central Statistical Authority (CSA) of Ethiopia. The data are compiled from different surveys that conducted since 1995 by CSA. The survey include: The Welfare Mortaring Survey (WMS), the Household Income Consumption Expenditure Survey (HICES), the Annual Agricultural Sample Survey and CSA[1] Annual Abstracts. The data taken from these various surveys are based on its importance for the study and the types of data needed for the analysis. But for all analysis the study uses cross sectional time series data which are known as panel data[2]. Using this type of data provides various advantages for the study outcome. A more substantive reason for favoring a panel approach to estimate is that one can control for the presence of individual fixed effect which are common to an individual economic agent across agent at any one time period. The second advantage is the panel data set is characterise with more variability and less collinearity among the variable than is the typical of cross-sectional or time serious data [3]. The third advantage is it increases precision of the regression estimates by increasing the sample size of the observation.

The study specifies the log-log equation that enables us to interpret coefficients as elasticity. In first section (section 3) the specified model presents the impacts of the WSS on the health status of the people. In the second section (section 4) the impact of WSS on the total crop production is presented. In this section the suitable data is collected from all regions over eight years based on the availability of the data. In the last section (section 5) one can see the impact of health status of the people and total crop production on the incident of poverty in the country.

The three equations are the major one which specified to link the WSS with poverty incidence. The typical relationship between WSS through health status and crop production is presented in chapter one section four. The reason behind for specifying the log-log model is that the data collected from different sources do not show a liner relationship. Then due to this reason the study specified the log-log equation which further enables us to get the elasticity of the poverty due to the change of the improvement of

health status and increase crop production through the availability of WSS.

Due to omitted relevant variables, sampling error and measurement problems the few explanatory variables are considered as an endogenous variable in the equation that specified by the study. The equation could not include all variables that affect the dependent variables due to unavailability of data. On top of this, the absence of uniform sampling technique and measurement standard at the national level would create the sampling error and measurement problem. The presence of endogenity due to these factors implies that there is potential correlation between explanatory variable/s and the random error term. This is in contrast to the Ordinary Least Square (OLS) assumption which said that there is no correlation between error term and explanatory variable. When explanatory variable are endogenous, OLS give biased and inconsistent estimation of the causal effect of an explanatory variable on an outcome. A quite general approach to control for endogenity is the Instrumental Variable (IV) method. The method of IV has traditionally been viewed as a response to a common problem in regression context, namely where one or more of the regressors on the right-hand side of the proposed equation are correlated with the equation disturbance [4].

Here the instrument is identified based on the theoretical relationship expected between the instrument and the explanatory variable/s. The two major assumptions considered during the selection of instrumental variable: Relevance[3] of the instrumental variable and exogenous[4] of instrumental variable[5]. The study believes that the WSS is not an exogenous variable that is free from any other external influence. Then the available instrumental variables are employed for WSS in the first two equations that specified in section 3 and 4. In the last model the study considered all the explanatory variables as an endogenous variable and due to this reason more instrumental variables are applied during the estimation process. The rationale behind of selecting a respective instrumental variable is presented in the analysis sections.

As mentioned above the major variables included in this study are: the number of sick people, the WSS coverage, the density of the people, the incident of poverty, the total crop production, cultivated area, literacy rate and dummy variables which used to capture the unquantifiable variables like policy changes, war and environmental variation in the country. Though the number of observations in each section is different due to the nature of the variables, a uniform estimation method is applied by using the data that come from different survey sources.

In this study the Fixed-Effect Instrumentals Variables (FE-IV) estimator method is used to estimate the impact of explanatory variables on dependent variable. This method enables the study to control time independent effects for each entity that are possibly correlated with the regressors. That means the geographical variation within the country needs to be control not to influence the estimation outcome. The major attraction of fixed effect methods in non-experimental research is the ability to control for all stable characteristics of the individual in the study, thereby eliminating potential large sources of bias [5]. The explanatory variables included in this study are more characterized by high regional heterogeneity.

For instance Addis Ababa is one well developed region in the country that included in the study with highest WSS provision as compared to Beneshangul Gumuze which the other emerging region with law WSS. Such wide regional variation in regional data included in the analysis may have a correlation between the error term and regressor. To control this time invariant heterogeneity, the suitable method is fixed effect estimator[6]. Fixed effect estimator is preferable than the random effect which do not take in to account the time invariant heterogeneity. For most observational studies, fixed effects methods are primarily useful for investigating the effects of variables that vary within subject (ibid).The study applied also the Random-Effect[7] Instrumentals Variables (RE-IV) before taking the estimation outcome of FE-IV. The Hausman[8] specification test is conducted to test the significance of the instrumental variables. In addition to this the necessary correlation test also conducted to see the correlation between the explanatory variables.

3. Impact of water supply and sanitation on health status

WSS improve the health status of the people by controlling the spread of water related communicable disease. When people get safe drinking water and basic sanitation, the water related morbidity would decline within the people which improve the health status of the people. Various studies explored the impact of WSS in different countries. For instance Rabindran S.et.al (2007) used the panel data to study the impact of piped water provision on infant mortality in Brazil. The estimation outcome revealed that the provision of piped water reduces infant mortality significant by the higher conditional quintiles of the IMR (Infant Mortality Rate) distribution than at the lower conditional quintile. Kirchbrger (2008) has undertaken a study in Ethiopia

on the choices of household's WSS on child health. The finding indicates that there is strong relationship between water and sanitation choices of a household and a child's weight-for-age z-scores[9].In the same way Abou-Ali H. and Carlsson F. (2004) conducted a study which shows the benefit of water quality improvement program related to health in metropolitan Cairo.

In this section the study analyses the impact of WSS on health status using suitable data available in the country. It uses panel data which are collected from WMS conducted by the CSA in the years 1998, 2000 and 2004.A total of 141 observations are taken for three years across the country at zonal level. Here the health status of the people is measured by the incidences of sickness during the two months of before the survey period. The illness of the people includes Malaria, Diarrhoea, Dental, Eye, Skin and Tuberculoses within the people during the survey period. The health status is a dependent variable which is measured by the number of sick people per thousand in respective area over the study years.

The other variable which included in this analysis is WSS coverage. This measure the number of people who has access to save water supply within 1kilo meter distance from their home in the rural areas and 0.5 kilo meter in the urban areas. It includes all types of source of water supply. The types of source of water supply are protected well spring, public tap and own tap. Sanitation refers to the availability of basic sanitation service to the people. It includes any types of sanitation facility. Sanitation facility in Ethiopia divided in to two types: pit latrine and flush toilet. It is believed that the health status and the availability of water supply and basic sanitation in the country has strong relationship. The incidence of sickness in the country is highly influenced by the availabilities of WSS. An estimated 60 to 80 percent of health problems are due to infectious communicable diseases and nutritional problems [9]. When people get enough drinking water and safe sanitation service, the level of the number of sick people would decline due to less contamination of food and drinking water that might cause for the higher incidence of illness within the people.

In addition to this, other variables like population density per squire kilo meter could affect the health status of the people. If the density[10] of people is very high in a particular area, then the number of people who would be sick per thousand declines due to the availability of other social service provision. In Ethiopia context most social services are available to more urbanized area or densely area as compared to the rural areas where people settled in scattered manner. But this does not mean that it would be true always. If the level of density of the people is very high beyond the availability of the social service, it may increase the number of sick people. The number of people per squire kilo meter is represented by density variable. Thus density is the other independent variable which is included in the health equation.

The third independent variable is the one which shows the government development activity. To improve the welfare of the people, the government has been undertaking new policy and institutional change since 2000. When the government designs a practical pro-poor development policy which focuses on the health, education and infrastructure development in the country, it reduces the incidence of sickness. This pro-poor development policy began and was implemented in Ethiopia since 2000. This change happened after the government realized the poor performance of the neo-liberalization reform program that was implemented between 1992 and 2000. The new developmental state[11] approach was implemented by the government to allocate more money on social service. Such financial resource allocation improves the social service provision which has direct impact on the health status of the people in the country. This new government development policy is represented by a dummy variable. 1 is assigned for 2000 and 2004. 0 is assigned for 1998.

As mentioned above WSS is an endogenous variable. The instrumental variables used to solve the endogenity problem are asset ownership, literacy and policy and institutional change in the WSS sector. The asset ownership of the people in particular area affects the WSS. People can afford more to get WSS, when they have some asset in terms of house or building as compared to those who do not have asset. In addition to these, the literacy level of the household determines the level of WSS. When people get literate, it increases their demand for WSS which improve the health status of the people.

The last instrumental variable is policy and institutional change in the WSS sector. The new regulation, policy change and institutional reform highly influence the provision of WSS. The policy change refers to the years since the new WSS policy have implemented by the government. Though the government formulated its official water sector policy in 1999, the practical institutional[12] reform could not happen immediately due to financial and technical problems. The establishment of new institutions was begun after 2000. This institutional reform has been completed in the year 2004. In this case 1 assigned only for 2004 and 0 assigned for 1998 and 2000. Equation 1 below shows the

functional relationship between the number of sick people and the explanatory variables that identified by the study. i and t represent the observation in a specific location and year respectively. As mentioned above the study uses only three years observation while it has around 141 locational observations throughout the country. Therefore, the equation explaining the health status of the people might be expressed as log-log model:

$$logSit = \alpha i + \beta 1 logWSSit + \beta 2 logDENit + \beta 3 DUMit + u_{it} \text{ - - - -(1)}$$

i = 1,2,3,...n t = 1,2,3....T

Where : S = Number of sick people

WSS = Numberof peoplewith acess to waterandsanitation

DEN = Populaion density

DUM = Dummy vaiable

β = Cofficient of variable

α and u represent the constant coefficient and random error term of the log-log equation. Table 1 below shows the statistical summary of variables that included in the study. The table reveals that the average number of sick people is 297 thousand. The minimum number of sick people is 4.4 thousand while the maximum number of sick people is 1 million. In the same way the average number of people who got WSS is 89 thousand. The minimum and maximum number of people who got WSS are 0.7 and 747 thousand respectively. The average number of literate people is 194 thousand while the maximum and minimum are 1.6 million and 1.8 thousand people respectively. In the same way the density of the people vary from the lower 0.70 people per square kilo meter to 7.3 thousand per a square kilometre. There is a wide variation in the all variables between the observations which included in the study. It implies that the higher inequality in the provision of social service in the country.

Table 1: Statistical summary of the variables

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
Number of sick people ('000)	141	297.4	237.1	4.4	1074.3
WSS	141	89100	108151.6	707	747812
Dummy policy and institution (instrumental var.)	141	0.33333	0.47308	0	1
Policy dummy	141	0.6666	0.47308	0	1
Density	141	356.76	1035.73	0.7094	7388.16
Literacy('000)	141	194	226.1	1.80	1.68
Asset ownership	141	46.13	108.70	0.1320	684.79

Source: Computed by Author from data compiled from CSA. Note; Obs=observation, Std. Dev. =Standard Deviation, Var. =Variable

Table 2 below present the estimation outcomes of the health equation. The estimation outcome indicates that the improvement in the WSS would reduce the incidence of sickness in the particular area. A unit percent increase in WSS would reduce the number of sick people by 0.12 percent. In the same way the change in the density of the people negatively affect the incidence of the sickness in the country. Most of highly densely area people can get basic social service easily as compared to the rural areas where people should travel a long distance to get basic health service. In addition to this most preventive health care information are available in more urbanized area than the rural areas.

In the same way the change in policy would reduce the number of sick people in the country. Here the policy change refers to the broad and wide development policy activities which undertaken since 2000.

Table 2: The random and fixed effect estimation outcome of health equation

	Random Effect Estimator		Fixed Effect Estimator	
Variable	**Coefficient**	**Std. Error.**	**Coefficient**	**Std. Error**
Constant	6.145449	0.17292	5.812243	0.3270918
WSS	-0.1315745	0.0378338	-0.1239494	0.0432107
Density	-0.0609601	0.0253365	-0.1917837	0.0938122
Policy dummy	-0.1893343	0.0453614	-0.1783799	0.0443052
R^2		0.3220	R^2	0.3184
Number of Observation		141	Number of Observation	141

Source: Computed by Author that compiled from data collected from CSA

For obvious reason this policy changes improve the health status of the people by reducing the number of sick people. The decline in the incidence of sickness came due social service provided to the people as a result of new policy measure. In this regard it can be easy to see the health sector policy that implemented in the country which increases the potential health service coverage from 50 percent in 1998 to 64 percent in 2004[13] .

The estimation outcome is supporting the above argument which said that the new policy implementation that undertaken in the country would reduce the incident of sickness. Accordingly, the change in the policy would reduce the number of sick people by 0.16. This variable has the highest influence on the health status as compared to the other explanatory variables included in the equation. It is due to the multiple impact of the policy on various sectors of the economy which improve health status more than WSS.

The main purpose of this section is to find out the impact of government WSS plan on the health status of the people at the end of the UAP. According to the government plan a total of 58 million people would get WSS both at the rural and urban areas. Then if the government achieve the universal program of WSS, in 2012 around 7 million people (1 million people per year) number of sick people would be free from sickness. This is the great benefit of WSS in improving the health status of the people in Ethiopia. This estimation

only included the impact of the WSS on the new beneficiary between 2006 and 2012, but if it could include the entire people who are using safe drinking water and basic sanitation as whole at the country level the impact of WSS on health status might be higher than the above mentioned number of people (7 million people).

4. Impact of water supply and sanitation on production

WSS increase the national agricultural production by increasing the labour productivity that enabling the household to have extra time on productive work[14].In addition to this, the provision of enough water supply and basic sanitation improve the health status of the people which increase the productivity of the labour who involved in the production process. In this section one will see the impact of WSS on the total crop production. Total crop production is represented by the regional level total crop production which includes cereal, pulses and other crop productions. In Ethiopia around 85 percent of people are living in the rural areas where their subsistence is depends on agricultural production. Most people food consumption in the country dominated by this type of production which indicates the crop production has an important contribution on the poverty reduction efforts in the country.

The first factor that affects crop production is land[15] used in crop production. When the land size increases, it affects positively total crop production. Guaranteeing the availability of land for people who are able and willing to make a living out of farming is fundamental and is a step in the right direction for proper use of land resources. A careful use of land resources per household is expected to contribute for sustainable increase in crop production. Here the study takes cultivated land size per household. The other factor of production that included in this study is labour. The availability of WSS improve the labour involvement in the crop production. Improved water supplies and sanitation services can lower the incidence of waterborne disease among users and wider community. The reduction in morbidity and mortality can raise labour productivity over the long run. Diarrhoea deaths strike mainly the young and old. But the lack of access to improved drinking water and sanitation affects people's lives at all ages [10].

According to Ghebremedhin (1999), in many part of our country it is not uncommon to find a household where someone has to spend more than 6 hours and half of their daily energy for getting drinking water to the family. Reducing the ill health and disease in children through improved WSS service frees the time of the adult who care for them for more productive activities. Pit latrines, when used by adults themselves and for the disposal of infant's stools, can reduce diarrhoea by 36 percent or more, cholera by 66 percent, and worm infestations by between 12 and 86 percent [9]. The availability of WSS enables the household to use these water fetching hours for crop production and other economic activities. In Ethiopia most of the working age grope affected by the water related disease which reduce the working hour of the labour in the crop production. When more people are accessed with improved drinking water and sanitation, it increases the total crop production by improving the labour productivity.

In order to improve the total crop production the government used various methods during the last decades. Policy makers in the country assumed that significant productivity could be easily achieved by improving farmer access to fertilizer, better seed and pesticide. The strategy which is known as the ADLI[16] sets out agriculture as a primary stimulus to generate increased output, employment and income for the people and as the spring board for the development of the other sector of the economy. But due to lack of knowledge about of the importance fertilizer at local level, on time availability of fertilizer[17], poor implementation of extension package program and increase in the price[18] of fertilizer, the amount of fertilizer utilization was very low as compared to government policy.[19]

The report compiled by World Bank (2007) revealed that the amount of fertilizer consumption in the country increased from 247 thousand metric tons[20] in 1994/95 to only 376 thousand metric tons in 2005/06. During the last eleven years, the fertilizer consumption increased by 4.7 percent. When one can see the fertilizer utilization per cultivated land area, there is no significant change in the level of fertilizer consumption per hectare. The amount of fertilizer used per hectare in 1994/95 was 35 kilogram per hectare. After eleven years the level of fertilizer utilization per hectare increased only by 2 kilogram per hectare (37 kilogram per hectare fertilizer utilization in 2005/06)[21].Apart from fertilizer and improved seed, irrigation and the use of modern farm modernization-other component-is almost non-existent (14). This implies that the total crop production increase mostly through labour and land by improving the existing practice. These situations do not enable the study to include fertilizer as a factor of production.

The provision of health service improves the productivity of the labour in addition by reducing the number of sick people and mortality of the people in the country. Farmers, whether skilled or unskilled, could not engage themselves in productive activities unless they lead a healthy life. There is, therefore, a need for establishing basic health services delivery system to the grass root farming population, particularly for those in remote rural localities. The Government plans to realize its health development objective through a twenty-year health development strategy, with a series of five-year investment programs, of which the first Health Sector Development Program (HSDP)[22] covers the period 1997/98-2001/02 G.C. The HSDP proposes a sector wide approach to achieve the Government's objectives. In this regard the health status of the people is taken as an explanatory variable that influences the total crop production over all the country. Households with poor health are less likely to adopt productivity-enhancing as well as resource-conserving technologies, which are crucial for achieving the ultimate goal of sustainable agricultural development [15].

In addition to this the study includes the dummy variable that represents the erratic nature of rain. Usually timely supplied with an adequate amount of water (rain) could play a major role in increasing crop production. The persistent lack of rainfall[23] is a major factor in reducing the crop production in Ethiopia. The dummy variable take the year the country face the delay of rain. Here 2004 is assigned 1 which indicates the year the country experience absence of on time seasonal rain. The other years are assigned 0.

On the other side the study could not include capital input which one expects that it has an impact on total crop production. The reason is, in Ethiopia context 90 percent of the agricultural productions is owned by small holder[24] which could not afford to use capital that may bring higher crop production. In addition to that the majority of the farmer has a land size less than a hectare which does not enable the farmer to use intensive capital.

$$logQ_{it} = \alpha i + \beta 1 logWSS_{it} + \beta 2 logLit + \beta 3 logHit + \beta 4 DUMit + uit - - - - - (2)$$

i = 1,2,3,...n t= 1,2,3...T

Where;

Q = Total crop production

WSS= Number of people access for water supply and sanitation

L = Percentage of cultivated area per household

H = Number of sick people

DUM= Dummy variable

β = Coefficent of variable

After all small holder farmers consume around 60- 80 percent of their production which do not enable them to pay for a new capital that need high initial cost.

The document prepared by Ethiopia National Strategy Team said that accelerated and sustainable growth in Ethiopia can be brought about by utilising labor-intensive rather than capital-intensive production processes. Therefore the study excludes capital from of production equation.

The instrumental variable that taken is the WSS policy and institutional change that implemented since 2004 in the country. Since the government started its poverty reduction programs, a number activity performed in giving special priority in preparing and implementing WSS policy. This new reform program creates an enabling environment[25] that increases the WSS coverage in Ethiopia.

The above relationships between crop production and explanatory variables can be specified by using the log-log equation. The model enable us the compute the elasticity of the crop production due to the change in the explanatory variables (WSS, cultivated land per household and the health status of the people).α and u represent the constant coefficient and the random error term. i and t represent the observation in a specific location and year respectively. Equation 2 below shows the log-log production equation.

The reform focuses on development and enforcement of appropriate management action for WSS service to achieve autonomy and commercial viability which recognise: The regulatory role of the government, the role of communication in decentralized management, the use of local skills and resources; and the involvement of private/informal sector entrepreneurs. These changes in policy and institutional reform would affect the provision of WSS. The changes reduce the constraint that encounters the provision of WSS services during their implementation time: National Steering Committee[26] , introducing new rule and regulation, providing financial and technical support for the sector are few of the new changes implemented since 2004.

Given the ecological diversities of Ethiopia, the WSS development efforts should be consistent with the particular conditions prevailing in each agro-ecological zone. Specialization and diversification need to be undertaken in an integrated and coordinated manner which not realized in the country during the study period. Due to this reason the study takes only the highland area than the low land area which needs more special policy than the existed new policy change. The life of people in lowland area is based on cattle breeding and mobility with cattle from place to place. This needs special WSS institutions which take into account the life style of the people. The dummy variable represents the major policy change in the country which brought positive economic performance. That means 1 is assigned for the years 2004 and 2006. The other years included in the study assigned 0 that show there is no significant policy change in these years. The low land area is dropped in this case due to the absence of suitable policy which fit with their respective area.

The following Table 3 shows the statistical summary for the variables included in the estimation. The table includes the statistical summary for total crop production, WSS, number of sick people, cultivated area per household and dummy variables which show the rain fluctuation and policy change. The total number of observation included in estimation varies from the minimum of 35 to the maximum of 70 observations. The average total crop production is 10.8 million quintal[27]. The average number of people who got WSS is 3.3 million people. The minimum number of people who got WSS is 34 thousand while the maximum is 19 million people.

The average number of sick people is 1.8 million which vary from the minimum 16 thousand to the maximum of 18 million people. The average percentage of cultivated area per household is .89 hectare while the maximum cultivated area per household is 2.2 hectare. The outcome of the estimation based on both the fixed and random effect instrumental variable estimators is presented in table 4 below. The sign of the coefficients of all independent variables satisfy the expectation of the study which said that the improvement in WSS increase the total crop production. On the other side also the increase in the number of sick people and percentage of uncultivated area reduce the total crop production in the country. The coefficient of WSS is

0.46 which show a unit percent increase in the WSS that would lead to an increase in total production by around 0.46 percent.

In the same way increase in the cultivated area per household would increase the total crop production in the particular area. According to the estimation outcome the increases in percentage of cultivated area per household by one percent, would lead to an increase in the total crop production by 1.15 percent. In other side the increase in the health status of the people by declining in number of sick people would lead to an increases total production. The coefficient of the number of sick people (health status) variable is -0.085 which implies that a unit percentage increase in number of sick people would reduce total production by 0.085 percent.

Table 3: Statistical summary of the variables

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Total Production (in Million Quintal)	70	10.8	18.1	0.043	73.8
WSS (in millions people)	70	3.3	4.1	0.034	19.0
Dummy-water policy	35	0.2857	0.4583	0	1
Cultivated area per household	60	0.892	8.93	0.265	2.242
Sick people (in Million people)	60	1.8	3.3	0.016	18
Dummy-Lack of on time rain	70	0.14285	0.3524	0	1

Source: Computed by the Author from data that compiled from CSA. Note; Obs=observation, Std.Dev.= Standard Deviation, Min=Minimum and Max=Maximum

Usually when people get sick their level of productivity would decline in addition the lost of time due to their sickness. Such decline in the total production has its own negative implication on the welfare of the people by reducing the income of the people which exacerbate the incidence of poverty in the country.

The final aim of this analysis is to observe the impacts of the government UAP effect on the total crop production at the end of 2012. As mentioned above the government planned to provide WSS for an additional 58 million people at the end of 2012. When the government provides WSS at the end of the plan years for additional 58 million people, the total crop production would increase by 26 million quintal. When people get enough drinking water and safe sanitation, they would get more time to involve themselves in the production activity. In addition to this the availability of WSS service protects people from various diseases that come due to contaminated water and food. The improvement of the health status of the people due to the provision of WSS would increase the total production. Such a situation increases the income of the people which leads to a decline in the poverty incidence in the country.

One needs other supportive measures which maximize the benefit that come from the provision of WSS. The availability of job opportunities and the proper functioning of the agricultural market enable us to see more effective and sustainable benefit of the WSS. In the absence of job opportunities and poor functioning of the agricultural market may not see the optimum benefits of the provision of WSS at the national or regional level. That is why most argue that the provision of WSS needs an integrated approach that can bring together all stockholders who are participating in the development activities of the country.

Table 4: The random and fixed effect estimator outcome of production equation

	Random Effect Estimator		Fixed Effect Estimator	
Variable	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
Constant	-2.4290	2.5057	-2.709779	2.774002
WSS	0.4635324	0.0733481	0.464139	0.0816749
Health status	-0.065457	0.033599	-0.0855402	0.0374963
Dummy-lack of on time rain	-0.1534063	0.0694736	-0.1533997	-0.0775033
Cultivated area per household	1.110096	0.3438374	1.15063	0.3966278
R^2		0.7926	R^2	0.7739
Total observation		70	Total observation	70

Source: Computed by the Author from data compiled from CSA.

5. Impact of water supply and sanitation on poverty

WSS reduce poverty through providing extra time for the poor people to get involved in wage earning activities that can improve their income. In addition to this, it enable the households to save health related expenditures that may be used for food consumption or use it during an external shock that may came due to fluctuation or shortage of rain. Ethiopia is one of the poorest countries which have very low provision of WSS that influence the people's involvement in the economic activities for the betterment of their lifes. But the availability of WSS by itself does not affect directly the level of poverty incidence, rather it reduces poverty through improving the productivity of the people to get more additional income. The productivity of the people increases when the water related diseases are controlled by the availability of drinking water and sanitation facilities. In addition to this the provision of water near to the village of households enables them to have extra time for wage earning activities. This clearly shows the impacts of the WSS in time saving and productivity of the households.

The previous two sections (section 3 and 4) in this chapter clearly demonstrated the impacts of WSS on the health status and total crop production in the country. These two variables (health status of the people and total crop production) have a significant impact in reducing the incidence of poverty in the country. In one of the world's poorest countries, where half of the population lives under the poverty line, agriculture is the main source of livelihood for more than eight out of ten Ethiopians [16]. The national strategy chimes with a widely held view that poverty reduction in Ethiopia is impossible without significant growth in crop production [14]. On the other side health improvement affects the poverty incidence in the country. Combating the disease that affects the poor will reduce their vulnerability to poverty-inducing health shock and increase their productivity. This will help to increase economic growth so as to reduce poverty [17].

This section analyzes the impacts of health status and total crop production on the incidence of poverty in Ethiopia. Before going to the estimation, one can see the concepts and measurements of variables involved in this section. The poverty incidence is taken as dependent variable and health status and total crop production are taken as independent variables. The independent variables are not an exogenous variable which implies that they are not free from other external factors. It is obvious that both the health status of the people and the total crop production are highly influenced by other variables which are not considered as an explanatory variable in the model. The study tried to include these variables through an instrumental variable. The possible instrumental variables included are: the percentage of cultivated area, the ratio of the land used fertilizer per total cultivated area, irrigated area, source of income and dummy variable that shows the policy change in the country that influenced the health status and the total crop production.

Poverty is deprivation of common necessities that determine the quality of life, including food, clothing, shelter and safe drinking water, and may also include the deprivation of opportunities to learn and to obtain better employment opportunity. The poverty line is defined by the total consumption of the people or the income that is required for getting the minimum level of consumption. The most widely used poverty measurement is the incidence of poverty (poverty head count index). The incidence of poverty (head count index) represents the proportion of the population whose consumption falls below the poverty line, that is, the share of the population that cannot afford to buy a basic basket of goods and essential non-food items [18]. The level of poverty line that was used to calculate poverty indices is 1,075 ETB at 1995/1996 national average constant prices. This poverty line was determined during the 1995/96 poverty analyses. It is based on the cost required for 2,200 kilo calories per day per adult in the country [19].

Three major national poverty line estimations have been conducted in the year 1995/96, 1999/00 and 2004/05[20]. In this analysis poverty incidence is taken as a dependent variable which is influenced by independent variables of the total crop production and health status. The health status is measured by the number of sick people in respective regions in the study years. In the same way the total crop production is measured by the total quantity of crop production produced in the respective regions over the years. Both explanatory variables are endogenous variables. In this section also the study included the instrumental variables to solve endogenity bias which arose due to missed relevant variables and measurement problems.

The source of income, irrigated area, amount of fertilizer used, total hospital bed per household, total number of households, education enrolment rate and dummy variable that represent policy change are the major instruments included in the poverty equation. The source of income refers to the number of people whose income depends on the agriculture at the regional level. Irrigated area also measured the cultivated area using irrigation. The more the farmer uses the irrigated area, the more is the crop

production and this reduces the risk of relying on high or low rainfall which is a common phenomenon in the country. The amount of fertilizer indicates the total amount of fertilizers used by the farmer. The common fertilizer in the country are dap and urea. Higher application of fertilizer enables the farmers to get more crop production.

The other instrumental variable is the total number of households in respective regions. When the number of households increases the land size declines which leads to a low crop production. This is a common situation in highland areas where the land size is highly fragmented due to increase in the number of households. The total number of hospital beds per household is another instrumental variable that would influence the health status of the people in respective regions. The more the number of beds per household in a given region, the better and proper in the health service provision which improves the health status.

The primary school enrolment is also included as an instrumental variable which is vital in changing the life of the people. Schools provide possible information about hygiene promotion which improves the health status of the people in the country. The last dummy variable is policy change. In 2004 the government implemented various development activities which affected both health status and total crop production in respective regions.

The dummy variable represents 2004, the year the country implemented a wide range of policy changes in all sectors. In that year, the broad range of poverty reduction strategy which allocated more resources for education, health and infrastructural development brought significant change in social service provision. Such a situation highly influenced the health status as well as the total crop production in the country at the regional and national level. In order to get the elasticity of the poverty in respect to the change in the health status of the people and total crop production, the study uses log-log model. The log-log model specified here helps us to get the influence of the crop production and health status on poverty incidence. Then the relationship between poverty incidence and explanatory variables can be presented in the following equation 3.

Table 5 below presents the statistical summary of the dependent and independent variables involved in the estimation which include the instrumental variables. Accordingly, the average number of people under poverty line is 2.5 million while the maximum number of people under poverty line is 8.4 million when the minimum is 242 thousand. The average number of sick people is around 1.3 million that ranged from the minimum of 14 thousand to the maximum of 6.1 million people. The average crop production is 10.5 million quintal. Correspondingly the average irrigated area is around 29 thousand hectares.

The maximum irrigated area is 631 thousand hectares. The maximum number of people whose income depends on agricultural sector is 21.4 million. On the other hand primary school gross enrolment rate is varies from the minimum 8.4 percent to the maximum 150.2 percent. In all observed variables one can see a wide differences between the regions.

Equation:3

$$logP_{it} = \alpha_i + \beta_1 logH_{it} + \beta_2 logQ_{it} + u_{it} \text{ - - - -(3)}$$

i = 1,2,3,..n t = 1,2,3...T

Where, α = Constant cofficient

P = Nnumberof people under poverty line

H = Numberof sick people

Q = Totalcrop production, u = Random error term

β = Cofficientof variable, n and T represent the number of observation andnumberof years

The final outcome is taken after the necessary post estimation test[28] conducted by the study. The estimation result shows that both variables have the expected outcomes. The poor health status and the poverty incidence have positive relationship. When the number of sick people increases the number of people under poverty also increases. In other words an improvement of health status by low number of sick people would lead to a decline in the poverty incidence. One can see in the table 6 below a unit percentage increase in the number of sick people would increase the poverty incidence by 0.33 percent. However the incidence of poverty and total crop production has a negative relationship. When the total crop production increases in a given year, it reduces the number of poverty incident. The estimated outcome of the poverty equation revealed that a unit percent increase in total crop production reduces the poverty incidence by 0.80 percent. This indicates that an increase in the total production plays a significant role in reducing the poverty incidence in the country.

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Number of people under poverty line (‘in millions)	30	2.5	29	0.242	8.4
Number of sick people (‘in millions)	30	1.3	1.82	0.014	6.1
Total crop production (in mill. quintal.)	30	10.5	17.7	0.04	62.3
Amount of fertilizer(‘000)	27	339.9	534.1	0.060	1,552.6
Irrigated area (in thousand Ha)	29	29.2	116.2	0.062	631
Number of people whose source of income is agriculture(in millions)	30	4.6	6.1	0.06	21.4
Ross primary enrolment (percent)	30	61.45	36.30	8.4	150.2
Number of household(‘000)	30	0.98	1.41	0.004	4.5
Dummy-policy change	24	0.333	0.48154	0	1
Total number of beds per household	30	31.8	107.9	0.003	534.6

Table 5: Statistical summary of the variables
Source: Computed by Author from data compiled from CSA. Note; Obs=observation, Std.Dev. =Standard Deviation, Min. =minimum and Max.=maximum

The estimation result shows that the impact of water supplies and sanitation on poverty through the improvement of health status and total crop production. In this regard as mentioned earlier in the previous two sections, if the government achieved the universal access program of WSS provision, the number of sick people would be reduced by 7 million and also an additional 26 million quintal crop production can be obtained from the provision of WSS. Then taking this in to account, the decline in the number of people under poverty line due to the improvement of health status and total crop production can be computed. When the number of sick people declines by 7 million, the number of people under poverty line would also decline by around 2.3 million people. In the same way the additional of 26 million quintal crop production would reduce poverty by around 20.8 million people. In general the total of around 23.1 million people would be out of poverty incidence due to the provision of WSS in the country at the end of 2012.

Table 6: The random and fixed effect estimation outcome of poverty equation

Variable	Random Effect Estimator		Fixed Effect Estimator	
	Coefficient	Std. Error	Coefficient	Std. Error
Constant	7.321591	3.422309	8.1014641	2.726722
Health status	0.3925329	0.1857937	0.3372931	0.1669054
Production	-0.7738137	0.3379745	-0.8068911	0.274893
R^2		0.1015	R^2	0.1289
Total Observations		30	Total Observations	30

Source: Computed by the Author from the data that collected from CSA.

All these analyses are empirical evidences that justify the impacts of WSS on poverty through the improvement of health status of the people and increase in total agricultural crop production. In a country where the majority of people relied on agriculture with high rate of communicable diseases, the benefit of the provision of WSS is substantial in speeding up the poverty reduction effort of the government in the country. According the MDGs plan, a total of 50 million people[29] (3.3. million people per year) would be expected to be out of poverty if the government can achieved all the eight goals of the millennium development which are expected to reduce the poverty by half between 2000 and 2015[30]. One of the MDGs is the provision of WSS which has a multiple benefit in reducing the poverty incidence in the country. This study revealed that the provision of WSS can reduce the poverty incidence by improving the health status of the people and total crop production in the country.

The above diagram summarise the outcome of the analysis of this study which shows the impacts of WSS on poverty during the UAP in Ethiopia. If the government can achieve the UAP, the country would benefit by reducing the number of sick people by 7 million. In addition to this, such provision of WSS would increase the productivity of the households which can bring about an addition of 26 million quintal of crop production. As mentioned above such

positive impacts of WSS on total crop production and health status would reduce the poverty incidence by 23.1 million people at the end of UAP. This clearly indicates that the provision of WSS can take the 46 percent of the MDGs poverty reduction that was planned by the government. It is impossible to achieve the MDGs poverty reduction without taking in to account the contribution of WSS in the day to day life of the people.

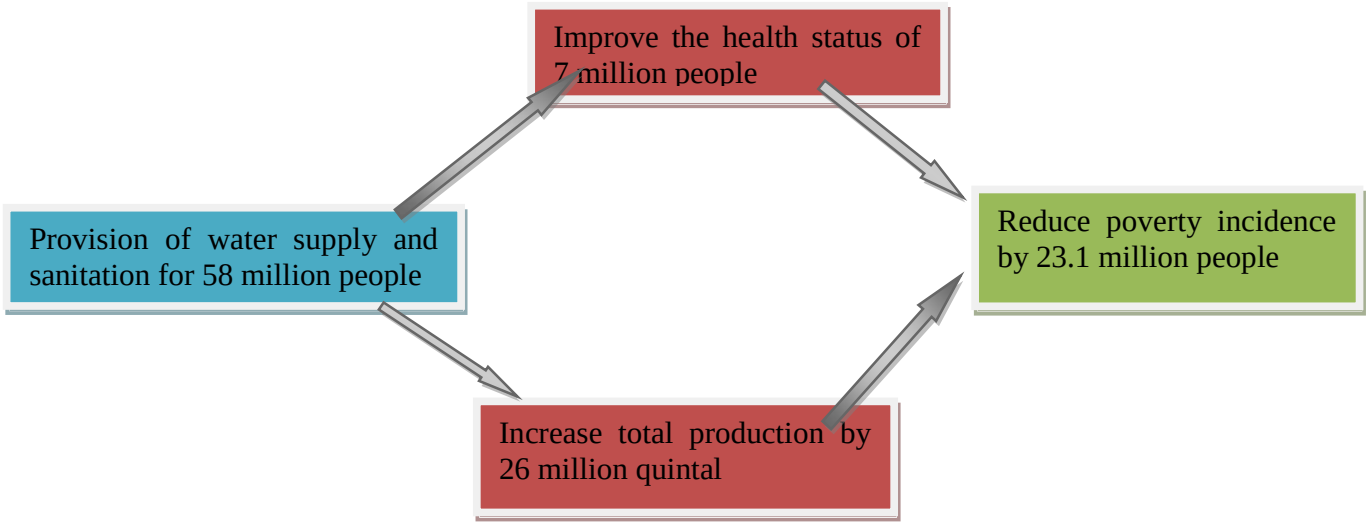

Fig. 1: The impacts of water supply and sanitation on poverty incidence through health status and production improvement during UAP

To realize the benefit of WSS, most countries including Ethiopia have already started giving special attention to the provision of WSS in their new poverty reduction strategy paper. The outcome of this study further encourages the commitment of Ethiopia government in providing WSS to make poverty history in the country.

6. Conclusion and recommendations

6. 1 Conclusion

Poverty is deprivation of common necessities that determine the quality of life, including food, clothing, shelter and safe drinking water, and may also include the deprivation of opportunities to learn and to obtain better employment opportunity. The provision of WSS plays the major role in reducing or controlling the prevalence of poverty in the country. Especially in Ethiopian context where the availability of WSS is at a low level as compared to any other developing countries [21], solving this problem brings a significant impact on reducing poverty through improving the health status of the people and total crop production. The secondary data were collected from various surveys collected by the CSA to analyze the impact of WSS on poverty. The cross section time series data were used to estimate the three equations which were developed by the study. The health, the production and the poverty equations are the functions estimated to find out see the impacts of WSS on poverty. The Fixed Effect Instrumental Estimator (FE-IV) was used to estimate the three equations.

The first estimation outcome revealed that the provision of WSS significantly affects the health status of people. The unit percentage increase in the WSS would reduce the number of sick people by 0.16 percent. In the second estimation, the provision of WSS would generate more crop production. In this case the unit percentage increase in the WSS would bring 0.46 percent of crop production. The last estimation revealed that the unit percentage improvement in crop production and health status reduce poverty incidence by 0.80 and 0.33 percent respectively. If the government achieved the universal access program of WSS at the end of 2012, around 15 million people would be out of poverty. This number is 30 percent of the MDGs poverty reduction plan of Ethiopian government by the end of 2015.[31]

6.2 Recommendations

Various challenges would encounter the effective provision of WSS in the country. The first problem is lack of consistent development plan [22]: Frequently revising and changing the development plan affect the important works of the provision of WSS. Rather than using scarce resources only to develop plans, it is better to use the resources for the provision of

water resources and sanitation. In this regard the study do not say that plan should not be revised by the government, rather when the government prepare its plan, it has to be in the way that does not force the government to make an entire revision.

Here the government has already developed the framework of water resource policy which needs to be planed according to the policy. The preparation of the donor driven development plans would weaken the effectiveness of the provision of water and sanitation provision in the country. Considering this problem the government should focus on implementation than frequent revision of its own plans. Usually no local level survey was applied to develop the plan. The government needs to allocate enough money and other supportive measures to conduct survey at the local level to prepare the national plan. The people at the local level should be aware of the national plan of the government to work with the regional or federal government.

The second problem is the lack of appropriate technology; the government should concentrate on technology that can be handled and managed at the local level. The appropriate technology should be superior to the technologies in the past. Yet it should also be simpler, cheaper, and easily maintained by the users themselves. Government should consider the points like (1) Manufacturing of technologies should be local. It means that villages should be able to obtain a suitable technology without external assistance (project or government agent), (2). The technologies should be affordable and should address real needs of the beneficiaries. (3) The production methods employed, must be relatively simple, so that the demand for high skills is minimized, not only in the production method itself but also in matters of organization, raw material supply, financing, marketing and so forth and (4) Production should be mainly from local materials and mainly for local use.

Though there is an effort in preparing guidelines for local WSS technology development, it needs more detailed work to consider the specific areas of water and sanitation provision. In addition to preparing the guidelines for all concerned bodies involved in water supply, it needs to set up regional/zonal level agencies that will coordinate the technologies transfer or diffusion. Besides these, all WSS technology should be able to meet the cultural, social, behavioural and economic conditions of the users.

The third problem is poor cost recovery and lack of funds: The other problem of WSS sector is the poor cost recovery and lack of funds. The government should take a bold stand and include the cost recovery in the project design and preparation. Besides this, the specific location pricing system should be strengthened to enable the provision of water supply to cover its cost. Water Tariffs should be set at levels sufficient to support system renewal and replacement as well as system expansion. Here the government should help the local community in price setting through providing various training on price setting mechanisms. The fixed pricing system should be replaced with the pricing system that can be determined by the quantity of water used by the household. This kind of pricing would ultimately reduce water wastage and increase the revenue which could be allocated to improve more the quality of water and sanitation provision. In addition to this the government should strengthen the rural and urban water fund to provide necessary financial service to the intended purpose. Further the recent pooled fund system should be used by all NGOs to reduce the delaying of fund release from external source.

The fourth problem is poor coordination and experience sharing practice: During the local level implementation of WSS provision, there are many set backs or lessons to be learned or shared with one another on local community or regional level. In this regard the government should play the catalyst role in providing experience sharing within, and between the regions. It can be done by organizing experience sharing conferences. This sharing experience should not just be done at the higher official lever but must be conducted at the local level. There must be a responsible body that picks the lessons learned at the federal and regional levels.

Once the information is gathered then the information should be disseminated to others. Thus, it should be designed with a follow up to evaluate the process vis a vis the new acquired experience. There has to be a responsible body that accounts that all regions are appraised of this new information. Here the responsible body will identify the challenges faced in the utilization of the new technology. Lack of integrated information system in WSS, absence of enough number of local manufacturers who assemble or produce spare part materials for the provision of WSS and poor community participation are the other challenges that would be an obstacle to the realization of UAP. The government should use effectively the newly formed forum like DAG thematic group/ donor task force, the NGO water coordination group, multi-stockholder forum, Poverty Action Network Ethiopia PANE network focusing on PRSP influence and monitoring and Woreda Forum.

The lack of private sector in the provision of WSS: The other problem is the lack of the private sector participation in the sector. To promote an effective construction of WSS infrastructure one need more

competent private sector that can provide on time service with lest cost and better quality. The study conducted by various study identified the possible place where the private sector can involve and improve the efficient provision of WSS provision in the country. Despite inviting the private sector in the sector the government should work on concrete works that increase the number of the private sectors. Though there is little progress in the involvement of private sector, still as compare to the massive work undertaken in the sector one need more private sector in various areas. In this regard the government should prepare clear guide line and regulation in private public partnership. Donor and /or regional government should also invest in the building of capacity for private and community water service provider to take up operation and maintenances. This would require a reformulation of law/proclamation for privatising operational and maintenance.

The last but not the least, provision of WSS is not only the final solution to bring the desired speedy poverty reduction in Ethiopia. The government should encourage the micro-enterprises with the provision of WSS to use the surplus time to wage earning activity that increases the return of investing on WSS. This enables people to use their surplus time for wage earning activity.

To summarize, though WSS is important for reducing the poverty incidence, but due to coordination effort and other problems the country may not achieve its MDGs poverty reduction goal unless the government and all stockholders take appropriate action for the problem identified in the sector.

REFERENCES

[1] The Federal Democratic Republic of Ethiopia Ministry of Water Resource, Urban and Rural Water Supply and Sanitation Services Universal Access Programs from 2006 to 2012.issued in 2005, Addis Ababa, Ethiopia.

[2] WSP (2003): Governance and Financing of Water Supply and Sanitation in Ethiopia, Kenya and South Africa, a Cross Country Synthesis, Sector Finance Working Papers: No. 5

[3] Lee W. (2006): Using panel data to characterise prisoner and demographic age characteristics, department of statistics, Harvard University.

[4] Roger V. et. al. (1990): Instrumental variables, Econometric Society Monographs in Quantitative Economics. Cambridge University Press, UK.

[5] Allison D. (2005): Fixed effect regression method for longitudinal data using SAS, SAS press, North Carlina, USA.

[6] Rabindran S., Khan S. and Timmins C.(2007): The impact of piped water provision on infant mortality in Brazil: A quantile panel data approach

[7] Kirchberger M. (2008): Do Households' Water and Sanitation Choices Really Matter for Child Health? University of Oxford, UK.

[8] Abou-Ali, H and F. Carlsson (2004), Evaluating the welfare effects of improved water quality using the choice experiment method, Working paper in Economics No.131, Department of Economics, Gothenburg University.

[10] WHO/UNICEF (2005): Joint Water Supply and Sanitation Monitoring Programme, Water for life making it happen, Geneva, Switzerland.

[11] Gebremedhin Y.(1999): Effects of insufficient water supply and sanitation, International development for water supply and sanitation, 25th WEDC conference, Addis Ababa, Ethiopia.

[12] MOH (2005): The Federal Democratic Republic of Ethiopia Ministry of Health, National Hygiene and Sanitation Strategy, To Enable 100% Adoption of Improved Hygiene and Sanitation, October 2005, Addis Ababa, Ethiopia.

[13] World Bank (2007): Project performance assessment report in Ethiopia, seed system development project, June 21, 2007, Written by Trish Silkin Addis Ababa, Ethiopia.

[14] Gebreselassie S. (2006): Intensification of Smallholder Agriculture in Ethiopia: Options and Scenarios, Paper prepared for the Future Agricultures Consortium Meeting at the Institute of Development Studies 20-22 March 2006.

[16] IFAD (2006): Enabling the rural poor to overcome poverty in Ethiopia, Rome, Italy.

[17] WHO (2002): Poverty and Health; A strategy for the African region, World Health Organization regional office for Africa Brazzaville.

[18] The Federal Democratic Republic of Ethiopia Ministry of Finance and Economic Development and UNDP, Ethiopia – MDGs Needs Assessment, Final Report Water Supply March 2005.

[19] The Federal Democratic Republic of Ethiopia Central Statistical Agency Welfare Monitoring Survey 1995, 2000 and 2004 analytical report, Addis Ababa, Ethiopia.

[20]The Federal Democratic Republic of Ethiopia Central Statistical Agency Household Income, Consumption and Expenditure (HICE) Survey 1995/96, 1999/00 and 2004/5, Addis Ababa, Ethiopia.

[21] MOWR (2006): Final Sector Review Report of Water Supply, Sanitation and Hygiene.

[22] The Federal Democratic Republic of Ethiopia Ministry of Water Resources, Ethiopian Water Sector Strategy, 2001.

.End Note

[1] CSA is an agency of the government of Ethiopia designated to provide all surveys and census for that country used to monitor economic and social growth, as well as to act as an official training center in that field.

[2] Data sets that combine time series and cross sections are called longitudinal or panel data sets.

[3] Relevance of instrumental variable indicated the high correlation between instrumental variable and repressor.

[4] Exogenous of instrumental variable is refers no correlation between the instrumental variable and the random error term.

[5] With an invalid instrumental and low correlation between the instrument and repressor, the IV estimator can be even more nconsistent than OLS (Cameron and K.Trivendi, 2005).

[6] Fixed effect method tends to reduce bias at the expense of greater sampling variability.

[7] Random effect methods do not control for unmeasured, stable characteristics of the individuals.

[8] Hausman's specification test, or *m*-statistic, can be used to test hypotheses in terms of bias or inconsistency of an estimator.

[9] A measure of how many standard deviation units from the mean a particular value of data lies.

[10] Density measure the number of people per square kilometre. This data is taken from annul CSA abstract report.

[11] A development state is characterized by having strong state intervention, as well as extensive regulation and planning

[12] Some of the new institutions introduced in the country include: The national steering committee(NSC);the National Technical Advisory group(NTAG);the regional Steering Committee(RSC);the regional Technical Advisory(RTAG) and Woreda Action Research Team(WART)

[13] Source Ministry of health annual report published in 2000 and 2006.

[14] Non productive force refers to the time spending of the household in non wage earning activities. For instance spending time for searching water and attending hospital for water related treatment.

[15] Of the 55 million ha of land estimated to be arable (suitable for cultivation), only 40percent is currently cultivated (Mekombe et.al, 2007).

[16] In addition to the agricultural policy (ADLI) the special extension package know as PADETES implemented in the country since 1993.

[17] Total dependence on fertilizer import also affect on time utilization of fertilizer.

[18] Increase in fertilizer retail price is mainly associated with the increase in the international price fertilizer.

[19] From 1998, the subsidy on chemical fertilizer was withdrawn and the price had more than doubled by 2007. In 2002, many farmers were heavily in debt and withdrew from the fertilizer schemes (ISIS, 2008).

[20] A metric ton is equivalent to 1,000 kilograms.

[21] The total cultivated area in the country increased from 6.96 million hectare in 1994/95 to 10.15 million hectare in 2005/06.

[22] The HSDP(Health Sector Development Program) emphasise the preventive and primitives aspects of health care while not neglecting essential curative service.

[23] Ethiopia has a total land area of about 112.3 million hectares. Of this, about 16.4 million hectares are suitable for producing annual and perennial crops. Of the estimated arable land, about 8 million hectares are used annually for rain-fed crops (Tadesse and M.Hassan, 2009).

[24] Small holder farmers who are dependent on low-input and low-output rain-fed mixed farming with traditional technologies dominate the agricultural sector (Tadesse and M.Hassan, 2009).

[25] The various enabling environment include the introduction of new water resource policy, water resource strategy, water sector development program, decentralization, water supply and sanitation program, water resource management proclamation, universal access program, training on ground water

development, and separation of regulatory role from service provision

[26] Roles and responsibilities of National Steering Committee are; Provide policies and guidelines that govern the action research, Prioritize action research agenda, Identify and mobilize resources, Disseminate/share information, including the definition of dissemination strategy (Beyene A.,2005).

[27] One quintal is equal to 100 Kilo Gram

[28] Post estimation test is conducted to see the multicollinarity of the explanatory variables and consistent of the estimation through spearman and fixed effect estimation respectively. This has been done for all estimation.

[29] At the end of the MDGs (2015) the total population of the country is projected to be 93.99 million. According to the MDGs, 50 million people would be out of poverty line including the additional population of during 2005 to 2015.

[30] The Ethiopian government planned to reduce the percentage of poverty from 45 percent in 2000 to 22.5 percent at the end of the MDGs.