International Journal of Development and Economic Sustainability

Vol.1, No. 1, March 2013, pp.15-30

Published by European Centre for Research Training and Development, UK (www.ea-journals.org)

IMPACT ANALYSIS OF MEDE TELILA SMALL SCALE IRRIGATION SCHEME ON HOUSE POVERTY ALLEVIATION: CASE OF GOROGUTU DISTRICT IN EASTERN HARATGHE OROMIA NATIONAL REGIONAL STATE ETHIOPIA

Jema Haji (PhD, Associate Professor of Agricultural Economics)

College of Agriculture and Environmental Sciences

School of Agricultural Economics and Agribusiness

P.O.Box: 233, Haramaya, Ethiopia

Mobile phone: +251 911780518

Haramaya, Ethiopia

Mohammed Aman (MSc, Lecturer of Agricultural Economics)

College of Agriculture and Environmental Sciences

School of Agricultural Economics and Agribusiness

P.O. Box: 50, Dire Dawa, Ethiopia

Mobile Phone: +251 922807095

Haramaya University, Ethiopia

Tewodros Hailu (MSc)

CISP (Comitato Internationale per lo Sviluppo dei Popoli)

Email: hailutewodros@yahoo.com

Addis Ababa, Ethiopia

Abstract: *The main objective of the study was to access the impact of Mede Telilasmall-scale irrigation scheme on household poverty alleviation in Gorogutu District of Eastern Hararghe, Oromia National Regional State, Ethiopia. To achieve the objective of the study, data were collected from 200 households, 100 from participants and 100 from non-participants in the irrigation scheme, in the study district. Descriptive statistics, the Foster, Greer and Thobeck (FGT) poverty indices and Propensity Score Matching (PSM) were used to analyze the data. The study revealed that the small-scale irrigation scheme significantly reduced the incidence, the depth and the severity of households' poverty in the study district. The empirical model also revealed that access to the irrigation scheme significantly influenced the households' consumption expenditure level. The Average Treatment effect of Treated (ATT) indicated that, the per capita consumption expenditure of irrigation users is 25% more than non-users of irrigation. These results indicate that the small-scale irrigation scheme improved the livelihood of households in the study district.*

Key words: Irrigation scheme, impact, household poverty, consumption expenditure, Gorogutu, Ethiopia

1.0 Introduction

In the words of Kamara *et al*. (2004) erratic rainfall have created uncertainty for agricultural production and hence emphasized a call for irrigation in Africa. For this, even if low cost traditional system irrigation technologies(such as use of either rope and buckets to lift and distribute water from shallow open wells or watering cans to lift water from streams) were suggested, their low delivery capacity and labor intensive nature make them highly unfavorable to African production function. This indicates the suitability of applying small-scale irrigation scheme for smallholder farming system that characterizes most sub Saharan African countries.

Ethiopia is one of the agrarian economy in East Africa with a total land mass of 1.13 millionkm^2. Of which, 1.12 millionkm^2 is covered by land and 0.01 millionkm^2 by water bodies. The country has an arable land area of 10.01% (0.11 millionkm^2) with only 0.65% covered by permanent staple crops according to the Ministry of Water Resource (MoWR, 2002). The Global Precipitation Climatology Center (GPCC, 2007) indicated that, Ethiopia has the mean annual rainfall of 812.4 mm and a range of 2031mm. While the Western highland areas of the country receive the highest annual rainfall of (1,600-2,122mm), the Eastern lowlands receive the minimum rainfall amount of (91-600 mm) per annum. The mean annual temperature is 22.2^{0}c with mean annual temperature of 4-5^{0}c in the highland areas and 31 ^{0}c at Denakil Depression, the lowest point in the country.

According to (Lawrence *et al*., 2004) there is no enough water for most farmers, in Ethiopia, to produce more than one crop per year due to lack of water storage and large spatial and temporal variations in rainfall. Furthermore; there are frequent crop failures due to dry spells and droughts which have resulted in a chronic food shortage facing the country. In contrast, the country was supposed to have high irrigation potential even if most of the farmers rely on rainfall for their farming. Whereas, the rugged topographic features as well as the lack of investment and technical capacity are indicated to be among major factors for low irrigation development in Ethiopia (Rahmato, 1999).

Among others, the contribution of irrigation to poverty alleviation depends on water management, input utilization, access to potential output market and socio economic characteristics of users (Bahattarai *et al*., 2002). Ceteris paribus, irrigation development have both positive socio-economic and some negative environmental impacts (Seleshi *et al*., 2007).

The full potential of agriculture in the study district could not be realized in the absence of proper development and efficient utilization of its water resource for irrigation. Given, the low income and land size holding of the farmers in the study district, small-scale irrigation scheme was found to be a proper and inclusive approach for improving the rural households poverty status. In other words, a sustained growth of food production and hence income by smallholders could be achieved with optimal water resource

development. This study is then intended to analyze the household poverty alleviation impact of Meda Telila small-scale irrigation scheme in Gorogutu district of Eastern Hararghe Zone, Oromia National Regional State in Ethiopia. For this, poverty indices were developed to compare poverty status of users and non-users of the small-scale irrigation scheme in the study district.

Most irrigation impact studies in Ethiopia, so far, focused on large scale schemes of high value cash crops for big but few commercial farms. On the other hand, less attention was given for the small scale irrigation schemes that may assist most smallholder farmers in the country through generating sustained farm income and employment opportunity in particular for women. As a result, this study can serve as a say for upcoming intervention programs, studies and policy makings.

2.0 METHODOLOGY OF THE STUDY

2.1 Description of the Study Area

Gorogutu district is located 420 Km East of the Capital, Addis Ababa, and 140 km North East of the Zone capital, Harar, Ethiopia. Besides, the total population of the district was 143,896 (73,512 male and 70,384 female) of which 93 percent live in rural areas. The agro- ecology of the district is divided into three: Highland (*dega*) that covers 23 percent of the district's total area; Midland (*weynadega*) that accounts for 29 percent and Lowland (*kola*) with 48 percentage coverage (CSA, 2007).The district has a mean land holding of 0.37 hectares per household with minimum and maximum mean holding of 0.18 hectares and 1.57 hectares per household. Agriculture, with rain fed crop cultivation of 96.3 percent and 3.7 percent livestock rearing, is the main source of household income and employment. Moreover; 95 percent of the households use mixed farming system and 1.5 percent of the households based their livelihood only on livestock rearing. As far as the land distribution is concerned, the district, with a total land area of 53,123 hectares, constitutes 54 percent cultivated land; 21 percent forest, plantation and grazing lands; 17 percent marginal lands and 8 percent of settlement and built-up areas as per the report of the District Office of Agriculture and Rural Development.

2.2The Mede Telila Small-Scale Irrigation Scheme

The Mede Telila small-scale irrigation scheme is established by diverting water from the Erer Mede Telila River in Mede Hinchini Kebele of the Gorogutu district. The river has an estimated discharge of 350 lt/sec. The irrigation scheme was developed in 1993 with total investment cost of 503, 421 Birr (Ethiopian currency) funded by IFAD and Community. The initial capacity of the irrigation scheme is an area of 100 hectares with gravity flow of water. Then, in 2003 a rehabilitation work, with additional cost of 1,270,150.73 Birr, was undertaken. Hence, the area command area increased from 100 to 130 hectares of

gravity water supply. With this capacity, the irrigation scheme is supposed to benefit 1260 households in the district (source).

2.3 Data Collection and Sample Size

This study was based on both primary and secondary data collected from households in Mede Hinchini Kebele of Gorogutu district in East Hararghe Zone, Oromia National Regional State, Ethiopia. For the primary data collection, on participant and non-participant households' socio-economic and demographic features, interview by enumerators with a pre-tested semi structured questionnaire was used. While for the secondary data, government institutions, non-governmental offices, community based organizations, research centers were used as main sources.

This study used a multi stage sampling technique of purposively selecting the Mede Hinchini Kebele, due to the implementation of the small-scale irrigation scheme, followed by two-stage random sampling. In the first stage, the sampling frame (with name of households) was obtained from the Kebele office and stratified into two groups of Irrigation scheme participants and non-participants. For this study, participants are those households, in the Kebele, who used irrigation (gravity or pumped) water from the scheme for more than two consecutive years. While the non-participants were those households, in same kebele, with no irrigation access from the scheme. The rationale for selecting the two groups (participants and non-participants) from same kebele was to minimize the problem of heterogeneity except for irrigation access. In the second stage, due to large number of non-participant households relative to participants in the kebele, 100 households from each group were randomly selected rather than using proportional sampling.

2.4 Methods of Data Analysis

To achieve its objective, this study used both descriptive statistics and econometric analysis. The descriptive statistics was used to compare participant and non-participant households with respect to head count index, poverty gap index, and squared poverty gap indices of poverty. To determine the impact of the small-scale irrigation scheme on household poverty alleviation, the Propensity Score Matching (PSM) econometric model was used. For this study, the per capita consumption of households was used, as a proxy, to measure their poverty level.

Among others, the non-parametric nature to balance covariates between participant and non-participant households and hence removing observable variables bias; conventional approach to assess the impact of a discrete treatment, irrigation scheme in this study case, on outcome (per capita consumption expenditure); and ability to build matched pairs from the participant and the non-participants that were similar in their observable characteristics were the reasons for using PSM for this study.

2.4.1 Poverty line (threshold level) identification

Poverty measurement mainly constitutes two major steps of identification and aggregation. in The identification step defines the criterion to be used for determining households as poor or non-poor. This can be made by setting a cutoff point in households' income space called the poverty line. Households' status, poor or non-poor, is then measured with respect to their position relative to this line. Accordingly, those households below the line are called households in poverty/ poor and those above the line are termed as households not in poverty/ non-poor (Sen, 1976).

Despite availability of the Direct Caloric Intake (DCI) and the Food Energy Intake (FEI) approaches to set a poverty line, this study used the Cost of Basic Needs (CBN) method developed by (Ravallion and Bidani, 1994). This approach of poverty line determination was used due to its ability to accommodate estimate of cost of food and other basic non-food requirements. In other words, the CBN considers basic non-food requirements to define the threshold/ poverty line. Accordingly, a food poverty line was constructed by valuing a basket of food items that meet the minimum energy requirement in kilo calories (kcal). The calorie contribution of the foods items is adjusted to attain the 2,200 kcal/person/day energy requirement. This was the minimum per day energy requirement for a person to keep up its normal activities as to the report of World Health Organization (WHO, 1985). Then, the share of non-food items was added to determine the consumption poverty line per day per adult.

After estimating the average household size, the minimum 2200 kcal per day requirement, the typical food bundle of the relative poor households, the calories of the food bundle, and the cost of the food bundle derived from the estimated psychological needs, the food poverty line (ZF) was estimated using the following formula.

$$ZF = \left[\frac{\frac{The\ avergae\ minimum}{calorie\ requirement}}{\frac{Calories\ in\ avergae\ for}{bundle\ for\ relatively\ poor\ HH}}\right] \times [Cost\ of\ the\ average\ food\ bundle] \qquad (1)$$

2.4.2 The FGT poverty index

According to Foster (2006), the poverty measure was a statistical function that translates the comparison of households well being and the choice poverty line into one number for the population sub-group. The additively decomposable poverty index, developed by (Foster *et al*., 1984) was used to measure the number of households below and above the poverty line. The general formula for the FGT measures in given by (2).

$$P_\alpha = \frac{1}{n} + \sum_{i=1}^{q} \left(\frac{g_i}{Z}\right)^{\propto} \quad (2)$$

Where α- is the poverty aversion parameter,

g_i - is the income shortfall of the i^{th} household,

Z - is the poverty line,

n- is the number of sample households, and

q-is the total number of poor in the sample

From equation (2), the poverty aversion parameter (α) refers to the concern attached to the proportionate shortfall from the poverty line. When$\alpha = 0$, the FGT measure gives the incidence of poverty that is also called the Head Count Ratio or simply Head Count Index. And it is defined as the percentage of people falling below the poverty line. When$\alpha = 1$, the FGT measure gives the depth of the poverty called Poverty Gap Index. When $\alpha = 2$, the FGT gives a measure called the severity of poverty index or squared poverty gap (Ravallion, 1994).

2.5 The Empirical Model Specification

Two groups of households were compared to analyze the impact of the small-scale irrigation scheme on their poverty alleviation. These groups were called participant households (the treatment group) and non-participant households (the control group). The non-participant households were used as a comparison group to examine the impact of the Mede Telila small-scale irrigation scheme on participant households in Gorogutu district. The outcome variable that was used for comparison, in this study, was households' consumption expenditure per day per adult equivalent. The average change in the outcome variable was estimated using PSM.

Participant households were matched with non-participants that were assumed to have same probability to participate in the small-scale irrigation scheme. The propensity score, probability of participation in the small-scale irrigation scheme, was estimated as a function of observable household characteristics using statistical models like Logit or Probit (Abadie, 2003).

The Average Treatment Effect of the i^{th} household (ATE^i), the difference in households' consumption expenditure per day per adult equivalent, can be expressed by: $Y_1^i - Y_0^i$. Where, Y_1^i is the consumption expenditure of the i^{th} participant household and Y_0^i the consumption expenditure per day per adult equivalent of the i^{th} non-participant household. Assuming D as household participation status in the irrigation scheme ($D = 1$ for participant and $D = 0$ for non-participant), the ATE^i in casual effect notion can be expressed by:

$$ATE^i = E\left(Y_1^i/D = 1\right) - E\left(\frac{Y_0^i}{D} = 0\right) \quad (3)$$

Where, $E\left(Y_1^i/D = 1\right)$ is the average consumption expenditure per day per adult equivalent for household with access to irrigation scheme and $E\left(Y_0^i/D = 0\right)$ is the average consumption expenditure per day per adult equivalent for household with no access to irrigation scheme. For the sample households in the study area, the Average Effect of Treatment on the Treated (ATT) can be expressed by:

$$ATT = E\left(Y_1^i - Y_0^i/D = 1\right) = E\left(Y_1^i/D = 1\right) - E\left(\frac{Y_0^i}{D} = 1\right) \quad (4)$$

One major challenge of impact evaluation was difficulty to simultaneously observe households consumption expenditure per day per adult equivalent with and without access to the irrigation scheme. In other words, the participant households could be different from the non-participants in other attributes than access to the irrigation scheme and creates a fundamental problem of casual inference. For this, construction of the unobserved (counter factual) outcome was advised. It was worthwhile to indicate that, the effectiveness of matching estimators for impact evaluation rests on assumption of common support and assumption of conditional independence.

The common support assumption states that, the test of the balancing property is performed only for observations with propensity score between the common support region of the participants and the non-participants propensity score i.e. between 0 and 1. While, the conditional independence assumption states that, the irrigation scheme assignment condition is independent of the post-irrigation scheme outcome. Mathematically this can be expressed by: $(Y_1^i - Y_0^i) \perp (\boldsymbol{D/X_i})$ (Fafchamps, 2007).

2.6 Definition of Dependent and Independent Variables

The dependent variable of this study was participation in the small-scale irrigation scheme with dummy values of 1 for households having access to irrigation and 0 for those having no access to the irrigation scheme in Gorogutu district. Moreover; the outcome variable for this study is consumption per adult equivalent incorporating the value of food and non-food items.

The dependent variable was assumed to be influenced by following independent variables. Each variable is defined with their hypothesis based on economic theory and results of previous empirical studies.

Total cultivated land (LHS/TLC): This is a continuous variable measured in hectares and it refers to the total land size the household cultivated. In Gorogutu district, most of the households were smallholder

farmers and the only possible way to increase the output level is by increasing productivity of the land. Hence, this variable was hypothesized to have a positive effect on consumption per adult equivalent as well as participation in the irrigation scheme.

Formal Years of schooling (Educ): This is a continuous variable measured in formal schooling years completed by the household head. Most previous studies indicated that the possibility to adopt and apply new methods of farming increased along with education level. Accordingly, this variable was hypothesized to positively influence participation in the irrigation scheme and hence the consumption per adult equivalent.

Age of the household head (Age): This is a continuous variable measured in years. Previous empirical studies found a two way relationship between age and participation in irrigation scheme as well as other agricultural technologies. Hence, this study did not hypothesize the sign of relationship between age of the household head and participation in irrigation scheme. Besides, the age squared variable was also included in this study analysis to identify the sign of relationship between middle aged household heads and participation in the irrigation scheme relative younger or older counter parts.

Household size (Hhsize): This is a continuous variable measured in total number of the household members living under the same roof. Due to positive and negative relationship between the household size and participation in agricultural technologies by previous empirical studies, this study did not hypothesized the sign of relationship between the household size and participation decision in the small-scale irrigation scheme.

Dependency ratio (Deprtio): This variable is measured as the ratio of household member not in the labor force, child or old, to those household members in the labor force. The dependency ratio reflects the pressure and responsibility on household member in the labor force. Hence, this variable was hypothesized to have a negative relationship with participation in the small-scale irrigation scheme i.e. as the dependency ratio increase, the participation decreases in the irrigation schemed decreases and vice versa.

Sex of the household head (Sex): This is a dummy variable with values of 1 if the household head is male and 0 otherwise. Due to unequal access to resources and decision making between male and female household member, the participation decision in the irrigation scheme was also assumed to differ between male and female household headed households. Accordingly, this study hypothesis zed that, female headed households were less likely to participate in the small-scale irrigation scheme in the study district.

Size of livestock holding (SLh): Livestock ownership is important not only for income generation but also as a saving option or proxy for household physical assets and risk management mechanisms. Besides, in a mixed farming system, livestock serve as a source of draught power, as a source of buffer stock and for milk production. This variable was hypothesized to negatively affect the household participation in the small-scale irrigation scheme in the study district. This was mainly because, those farmers with large

livestock holding were expected to be better of in their poverty status and need to focus on livestock related enterprise than crop production.

Occupation of household head (DMPOHH): This is a dummy variable measured with values of 1 if the household head's primary occupation is farming and 0 otherwise. Those household heads that have agriculture as their primary occupation were assumed to highly participate in the small-scale irrigation scheme than those household heads with primary non-agricultural occupation. Hence, this variable was assumed to affect the participation decision in the irrigation scheme positively.

Total household farm income (Infarm): This is continuous variable measuring the total income the household obtained from farming (livestock and/or crop production). The livelihood of most rural households in rural Ethiopia rely on agriculture and income level obtained from this sector helps to determine their food security as well as the poverty status. This variable is assumed to affect participation in the small-scale irrigation scheme negatively in the study area. In other words, those household having more farming income were less likely to participate in the irrigation scheme.

Household Off/non-farm income (Ofnincome): This is a continuous variable, expressed in Birr, measuring the total off/non-farm income the household obtained. Participation in off/non-farm income generating activities is assumed to be positively related with household consumption expenditure and negatively with participation in irrigation activities. So, this variable was hypothesized to affect participation in the small-scale irrigation scheme in the study areas negatively.

3.0 Results and Discussion

3.1 Sample Households Characteristics

The mean age for the sample household heads was found to be 37 years with no significant difference between irrigation users and non-users mean age of 36 and 37 years, respectively. Among irrigation users, 96 of the households were male headed and four of them were female headed. While for non-irrigation users, the 86 households were male headed and 14 of them female headed households. The chi-square value shows a significant difference between users and non-users sex of households' i.e. irrigation users household head were significantly male headed relative to non-irrigation users. There was also a significant difference between users and non-users households dependency ratio in the study district. In particular, the dependency ratio for the sample households, 1.34, in the study district was even higher than the urban and rural national average dependency ratio of 1.04 and 1.07. The average household size for the sample households was found to be approximately six with mean landholding of 0.33 hectares. The major occupation of the household heads in the study district was found to be farming i.e. 194 out of 200 (Table 1).

Table 1. Demographic characteristics of sample households in the study district

Variables	Users		Non-users		Total		
	Mean	Std	Mean	Std	Mean	Std	χ^2-value
Age	36	8.65	37.76	9.38	37	9.01	0.69
Age ^{2}	1434	701.31	1512	797.44	1473	750.07	0.74
Sex (%)	0.96	0.20	0.86	0.35	0.91	0.29	6.12**
Deprtio	1.25	0.57	1.42	0.73	1.34	0.66	1.85*
Hhsize	5.86	1.69	5.60	1.58	5.73	1.64	-1.12
Educ	2.66	2.53	1.55	2.45	2.11	2.54	-3.16***
Land size	0.29	0.15	0.37	0.18	0.33	0.17	3.05***
livestock	3.10	1.98	3.16	1.55	3.13	1.78	0.25
Occupation	0.99	0.10	0.94	0.24	0.97	0.18	3.70*

Source (Authors survey, 2010).

3.2 Households consumption expenditure and non/off farm income

The result obtained from the survey indicates that the mean annual consumption expenditure of irrigation users, 2391 birr, was significantly higher than the non-users, 1825 birr. Besides, the farm income, both from cop production and livestock rearing, was also significantly higher for users of the irrigation scheme in the study area. No significant difference was obtained for users and non-users of the irrigation scheme with respect to their non-farm income. To identify existence of significant difference in livestock income between users and non-users of the irrigation scheme, an estimate was also made. The result indicated that the income users obtained from livestock and livestock products was significantly higher than their counter parts/non-users (Table 2).

Table 2. Consumption expenditure, farm and non-farm income of users and non-users

Variables	Users		Non-users		Total		
	Mean	Std	Mean	Std	Mean	Std	χ^2-value
Consn exp*	2391.05	91.44	1825.83	69.32	2108.44	857.53	4.93***
Farm income	13268.75	6218.07	6531.02	3139.17	9899.89	5961.86	9.67***
Non-farm income	1385.81	179.96	1258.69	1647.59	1322.25	1722.14	0.52
Livestock income	3479.54	3297.28	2295.29	2496.56	2887.42	2976.88	2.86***

*Annual consumption expenditure

Source (authors own computation during the survey, 2010)

3.3 Poverty lines estimate for the sample households in the study area

The Cost of Basic Needs method of poverty line estimation was applied and three levels poverty line were also estimated based on 25% plus on food poverty line and 75% plus on food poverty line. These two poverty lines were called the moderate and the extreme poverty lines respectively. The third poverty line was that of the food poverty line. To account for non-food consumption expenditure of sample households, the food poverty line was divided by the food share of the poorest quartile. The estimate made for the three poverty lines was given in (Table 3).

Table 3. Alternative poverty lines estimate for the study area

	Food poverty line (Birr/adult/year)	Kcal per adult equivalent	Total poverty line (Birr/adult/year)
Types of Poverty lines			
Absolute	1190.27	2200	1803.42
Moderate	1389.95	2750	2105
Extreme	990.60	1650	1500.91

Source (Authors own survey, 2010).

The moderate and extreme poverty lines for the sample households, in the study area, were found to be Birr 990. 60 and Birr 1389.95 per adult per year. The food poverty line was also found to be Birr 1190.27 per adult per year. The values given in last right hand column were obtained after adjusting for the non-food expenditure (Table 3).

3.3 Sample households poverty status

In this section, a separate estimate was made for the whole sample as well as for irrigation scheme users and non-users. Accordingly, the result for the aggregate poverty indices for the sample households was presented in (Table 4). While, the poverty indices result for users and non-users of irrigation scheme was give in (Table 5).

The survey result showed that, 41% of the sample households were under absolute poverty and hence unable to meet the minimum calorie intake requirement of 2200 Kcal per adult per day for their household members. This value was give by the absolute head count index (P_0) of 0.41. In other words, the aggregate poverty deficit (P_1) of the poor relative to the poverty line was nine percent. While the poverty severity

index (P_2), taking into account the consumption distribution of households falling below the poverty line, was found to be only three percent (Table 4).

Table 4. Poverty indices for the sample households in the study area

	Moderate poverty line		Absolute poverty line		Extreme poverty line	
Indices	Index	Std .err	Index	Std .err	Index	Std .err
P_0	0.605	0.035	0.410	0.035	0.210	0.029
P_1	0.152	0.012	0.090	0.010	0.043	0.007
P_2	0.054	0.006	0.030	0.004	0.014	0.003

Source (Authors own survey result, 2010).

Table 5. Irrigation user and non-user households' poverty indices in the study area

	Users			Non-users		
Indices	Moderate	Absolute	Extreme	Moderate	Absolute	Extreme
P_0	0.480	0.270	0.110	0.730	0.550	0.310
P_1	0.091	0.043	0.015	0.213	0.137	0.070
P_3	0.026	0.011	0.003	0.082	0.486	0.024

Source (Authors own survey result, 2010).

As far as the absolute poverty head count index was concerned, 55 % of irrigation scheme non-users were under absolute poverty while this figure is only 275 for irrigation scheme users in the study area. The absolute poverty deficit index (P_1) was also higher for non-users, 13.7%, than users, 4.3%. Finally, the absolute poverty severity index (P_2) result also showed major difference between users, 0.3%, and non-users, 48.6% (Table 5).

3.4 The Econometric Model Results

3.4.1 Propensity Score Matching (PSM)

To identify the factors that affect participation decision of households on small-scale irrigation scheme, the Logit model was used to generate propensity scores fro the matching algorithm. The result obtained was presented in (Table 6).

The likelihood ratio chi-square value, 48.33, was found statistically significant at 1% significance level. This implies that, the model was statistically significant and the regression coefficients give the change in the Logit index or z-score for a unit change in the predictors. Moreover; the small value of Pseudo-R^2 (0.196) indicates that there was no systematic difference in the distribution of covariates between irrigation scheme users and non-users in the study area.

Table 6. The Logit estimate of factors affecting participation decision in the irrigation scheme

Variables	Coefficients	Std .Err	Z	P>|Z|
Constant	-5.26*	3.04	-1.73	0.08
Age	0.14	0.13	1.05	0.29
Age^2	0.00	0.00	-1.14	0.25
Sex	1.07	0.65	1.64	0.10
Dependency ratio	-0.90***	0.32	-2.87	0.00
Family size	0.26*	0.14	1.86	0.06
Education	0.24***	0.08	3.10	0.00
Land size	-3.02***	1.02	-2.96	0.00
Livestock	-0.09	0.10	-0.92	0.36
Occupation	2.29*	1.21	1.89	0.06
Logistic regression			Number of obs = 200	
			LR chi2 (11) = 41.86	
			Prob > chi^2 = 0.00	
Log likelihood = -117.70			Pseudo R^2 = 0.15	

Source (Authors survey data, 2010)

Among the factors assumed to affect the household participation decision in the small-scale irrigation scheme in the study district, dependency ratio and land size holding negatively and significantly affected

participation in the scheme. Family size and education of the household head affected participation decision in the small-scale irrigation scheme positively and significantly.

The labor intensive nature of the irrigation scheme excluded households with small family size and high dependency ratio from participation. In other words, households with large family size were more likely to participate in the small-scale irrigation scheme in the Gorogutu district. These results were in line with the findings of (Haile, 2008; Shimelis, 2009).

Since, the Mede Telila small-scale irrigation scheme in Gorogutu district mainly focused on and incorporated poor farmers with small farm size holding. As a result households with large farm size where unlikely to participate in the irrigation scheme. This was shown by negative coefficient of Farm size (-3.02) and significant at one percent significance level. Such negative relationship between farms size and participation in irrigation scheme was also found by different authors in different parts of the country (Gebrehawaria *et al*., 2009; Tewodros, 2010).

3.4.2 Average impact of the irrigation scheme on consumption expenditure

To identify the impact of access to irrigation scheme, the average annual per capita consumption expenditure was compared for users and non-users. The result obtained indicate that, the average annual per capita consumption expenditure of irrigation scheme users, Birr 2431. 39, was higher than non-users, Birr 1825. 83. This implied that, the irrigation access increased the per capita consumption expenditure of scheme users by Birr 605. 56 or by 25% (Table 7).

Table 7. The average treatment of the treated households in the study area

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
Consumption	Unmatched	2391.05	1825.83	565.22	114.75	4.93
	ATT	2431.39	1825.83	605.56	100.45	6.03

Source (Authors own survey, 2010)

4.0 Summary and Conclusions

This study aimed to assess the impact of Mede Telila small-scale irrigation scheme on 200 rural households in Gorogutu district of East Hararghe Zone of Oromia National Regional State, Ethiopia. The working hypothesis of this study was irrigation scheme has an impact on household welfare, using consumption expenditure as a proxy. Accordingly, the mean cultivated land size was 0.29 hectare for irrigation scheme users and 0.36 hectares for non-users. Besides, off-farm and livestock income were significantly higher for

irrigation scheme users than non-users in the study area. The incidence of poverty was significantly lower among irrigation users with 27% than non-users of the irrigation scheme of 55%. These results indicate that the small-scale irrigation scheme has a profound effect on households consumption expenditure in particular for smallholders. Hence, such schemes for need to be encouraged in future.

The following recommendations, which can possibly be applied in other rural areas in the country, were drawn based on findings of the survey results in Gorogutu district of East Hararghe Zone. There is a need to expand the capacity of the small-scale irrigation scheme in the study district due to significant welfare, consumption expenditure, effect of the scheme on participants' households. This is mainly because, irrigation is the best alternative way to sustain food production and hence consumption expenditure of households with small land holding in the study district. Furthermore; to accelerate economic growth and poverty reduction in study area, as well as in other rural parts of the country where smallholders are relying on agriculture for their livelihood, access to small scale irrigation like the Mede Telila scheme need to be promoted and expanded. It is also worthwhile to indicate that, access to small-scale irrigation scheme do not have to be taken as the only solution for poverty alleviation. Rather, it needs to be combined with other infrastructures and poverty alleviation measures to achieve the desired target.

REFERENCES

Abadie, A., 2003. Semi-parametric instrumental variable estimation of treatment response models. *Journal of Econometrics*, 113:231-263.

.Bahattarai, M., R. Sakthivadivel and I. Hussain, 2002. Irrigation impact on income inequality and poverty alleviation: Policy issues and options for improved management of irrigation systems Colombo. International water management institute, Sri Lanka.

CSA (Central Statistics Authority), 2007. Statistical Summary Report on Population and Housing Census of Ethiopia, Addis Ababa, Ethiopia.

Fafchamps, M., 2007. Program evaluation and treatment effects. Oxford University, Michelmas, UK.

Foster, J., J. Greer and E. Thorbecke, 1984. A class of decomposable poverty measures. *Econometrica*, 52: 761-766.

Foster, J.E., 2006. Inequality measurement in the Elgar companion development studies. D. Clark ed, Edward Elgar.

Gebrehawaria Gebregziabher, Regassa Namara and S. Holden, 2009. Poverty reduction with irrigation investment: An empirical study from Tigray, Ethiopia. *Agricultural water management*, 96(12): 1837-1843.

GPCC (Global Precipitation Climatology Center), 2007. Available online at http://gpcc.dwd.de.

Haile, T., 2008. Impact of irrigation on poverty reduction in Northern Ethiopia. A PhD dissertation presented to the Department of Food Business and Development National University of Ireland, Cork, p. 200.

Kamara, A., G. Danso, S.A. Mahu, O. Cofie and P. Drechsel, 2004. Agricultural water investments and poverty impacts in West Africa: A review of treadable pumps with a focus on Ghana and Niger. An unpublished draft paper.

Lawrence, M., M. Osman and P. Sauerborn, 2004. A preliminary assessment of characteristics and long term variability of rainfall in Ethiopia. *European journal of clinical nutrition*, 48: 38-45.

MoWR (Ministry of Water Resource), 2002. Water and development quarterly bulletin, Vol. 4 No. 1, Addis Ababa, Ethiopia.

Rahmato, D., 1999. Water resource development in Ethiopia: Issues of sustainability and participation. Forum for social studies, Addis Ababa, Ethiopia.

Ravallion, M. and B. Bidani, 1994. How robust is a poverty profile? *World Bank Economic Review*, *World Bank Group*, 8(1): 75-102.

Ravallion, M., 1994. Poverty comparisons: Fundamentals of pure and applied economics. Volume 56, Chur, Switzerland, Harwood Academic publishers.

Seleshi, B., D. Aster, L. Mokonnen, W. Loiskadl, A. Mekonnen and A. Tena, 2007. Water resource and irrigation development in Ethiopia. Work paper 123, International water management institution.

Sen., A.K., 1979. Issues in the measurement of poverty. *Scandinavian journal of economics*, 81(): 285-307.

Shimeles M., 2009. Impacts of productive safety net program on households assets protection. The case of Habru and Ambasel districts in Amhara Region, Ethiopia. MSc presented to the School of Graduate Studies (SGS) at Haramaya University, Ethiopia.

WHO (World Health Organization), 1985. Physical status: The use and interpretation of anthropometry. WHO technical report series 854, Geneva, Switzerland.

Corresponding author's email address : mamiye2012@gmail.com

APPENDIX

Appendix Table 1. Covariate imbalance test

Variable	Sample	Mean		% bias	% reduct.	t-test	
		Treated	Control		| bias |	T	P>|t|
Pscore	Unmatched	0.61	0.39	106.7		7.55	0.000
	Matched	0.59	0.59	-0.2	99.8	-0.01	0.988
Age	Unmatched	36.88	37.76	-28.6		-2.03	0.044
	Matched	35.16	37.23	-24.5	14.3	-1.65	0.101
Age^2	Unmatched	1303.10	1512.90	-29.7		-2.10	0.037
	Matched	1292.30	1478.60	-26.4	11.2	-1.80	0.074
Sex	Unmatched	0.10	0.08	7.0		0.49	0.623
	Matched	0.105	0.03	25.6	-268.4	2.02	0.045
Depratio	Unmatched	1.25	1.42	-26.2		-1.85	0.066
	Matched	1.25	1.22	5.8	78.0	0.43	0.666
Famsize	Unmatched	5.86	5.60	15.9		1.12	0.263
	Matched	5.76	6.09	-20.6	-29.6	-1.34	0.182
Education	Unmatched	2.66	1.55	44.6		3.16	0.002
	Matched	2.46	2.75	-11.4	74.4	-0.73	0.467
TLU	Unmatched	0.29	0.36	-43.2		-3.05	0.003

	Matched	0.29	0.29	-2.1	95.2	-0.15	0.879
Land size	Unmatched	0.05	0.07	-42.7		-3.02	0.003
	Matched	0.05	0.05	1.8	95.8	0.15	0.884
Livestock	Unmatched	3.10	3.16	-3.5		-0.25	0.805
	Matched	3.18	3.37	-10.8	-210.6	-0.82	0.412
Occupation	Unmatched	0.99	0.94	27.3		7.55	0.000
	Matched	0.99	0.98	5.8	78.9	-0.01	0.988

Source: Authors survey result, 2010.