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The role of small scale irrigation in poverty reduction

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Poverty is of multidimensional characteristics affecting nearly a billion world population. Especially, a third of sub Saharans fall under poverty. The emergence of climate change coupled with the incidence of drought, are worsening the situation. The only option to escape this challenge is through the development of water resource projects. In attempting to do so, Ethiopia has yet developed not more than 5% of the irrigation potential. Much of this is owned and poorly managed by small holder farmers. The purpose of this study is thus to investigate whether small scale irrigation schemes contribute to poverty reduction or not. Based on 313 sample households from the Rift Valley Lake Basins, it was observed that irrigation improved household income and contributed to poverty reduction. However, the enhanced poverty impact of irrigation was constrained due to unsatisfactory performance and imperfect market. Thus, enhancing the capacity of water user associations through provision of training, market linkage and finance are a necessary step to improve irrigation performance towards poverty reduction.

Key words: Ethiopia, lake basin, rift valley, binomial logit.

INTRODUCTION

Ethiopia is predominantly an agricultural country where agriculture accounts for about 45% of the country's Gross Domestic Product (GDP), 65% of the total exports and 85% of employment (MoFA, 2007). One of the features of the Ethiopian agriculture and the national economy at large is its inability to produce sufficient food to feed the population (Samuel, 2006). In history, Ethiopia is characterized by famine as a result of high population pressure, resource base depletion and drought that affects the rain-fed agriculture significantly (Berhanu, 2001; Bruce et al., 1994). It has been documented that low farm production and productivity resulting from use of backward technology and other productivity-enhancing modern inputs are the major reasons for rampant poverty and food insecurity in rural areas (FDRE, 2010; Samuel, 2006). Poverty reduction is the first millennium development goal. Poor countries like Ethiopia were expected to halve the number of people living below one dollar by the end of 2015 (MoFED, 2010). Since 1992, the Government of Ethiopia has been carrying out measures to reduce poverty in the context of a series of reform programmes in the political, economic and social spheres (FDRE, 2003, 2010). Thus, following government efforts, poverty has declined from 45.5% in 1995/1996 to 29.6% in 2010/2011 (MoFED, 2012). Consensus has been reached by the government and donors that any solution to further reduces rural poverty must focus on increasing the production and productivity of smallholder agriculture (FDRE, 2010). Creating access to fertilizer, improved seeds, agricultural credit and thereby bringing significant growth in crop production is the major concern of national strategy (Samuel, 2006).

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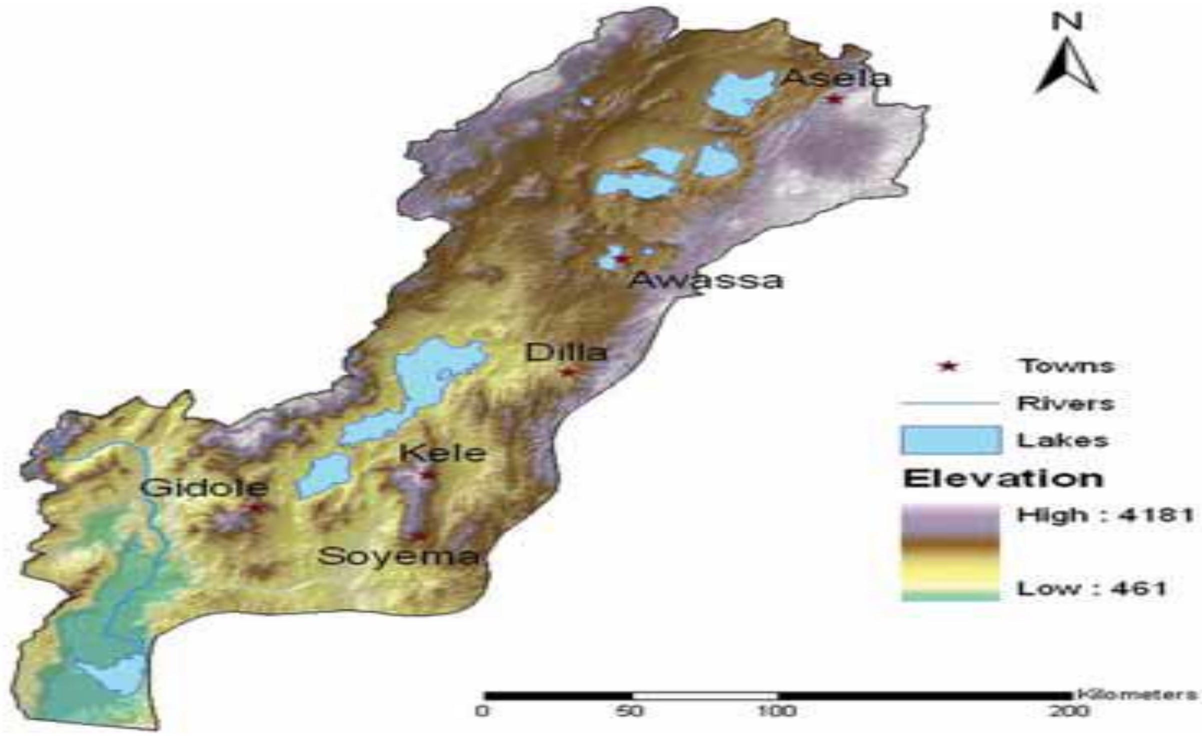

Figure 1. Ethiopian rift valley river basin (Bekele et al., 2007).

While technology is important, the issue of drought and rain fall variability is of paramount important. In order to address these challenges as a vital resource in agriculture, irrigation water contributes a lot in productive and livelihood activities of farmers.

Ethiopia is a water tower of Africa. A large number of rivers flowing on either side of the rift valley form a drainage network that covers most of the country. The government has focused to develop the sub-sector to fully tap its potentials (Mekuria, 2003; MoFED, 2006, 2010). Special attention is given to small scale irrigation development for their low capital requirement. In spite of this, the attention paid for this sector, the development of irrigation has not picked up. Even though some efforts have been underway to develop small scale irrigation (SSI) schemes; yet, Ethiopia has developed only 5% of the irrigable land (World Bank, 2006). Furthermore, it is noticed that the existing irrigation farms are operating at sub-optimal levels and many of the SSI projects have been operating below the required economic efficiency (Getaneh, 2011; Mekuria, 2003). Several studies have documented poverty-related benefits and costs of irrigation (Hussain, 2004). Most of them indicated irrigation can increase production and productivity. This, in turn, opens up new employment opportunities, both on-farm and off-farm, and can improve incomes, livelihoods and the quality of life in rural areas (Getaneh, 2011; Hussain, 2004; Oni et al., 2011). However, there are no available studies that assessed the poverty impact of SSI in the Ethiopian rift valley lake basins.

The purpose of this study is therefore to answer whether small scale irrigation schemes; while under performing, contributes to poverty reduction or not in the study sites. Since poverty reduction is the ultimate measure of development effectiveness; this study investigated the role SSI played in rural poverty reduction. The remainder of this study presents methodology, results, discussions and conclusions.

METHODOLOGY

The study site

The rift valley basin has an area of 52,739 km^2, covering parts of the Oromia, SNNPR regions. The total mean annual flow from the river basin is estimated at about 5.6 BMC. Large-scale irrigation potential is estimated at 45,700 ha with an estimated total irrigable area of 139,300 ha (Figure 1). The basin is endowed with a number of lakes of varying size with high environmental significance (Bekele et al., 2007).

Sampling and data

Multistage sampling procedure was followed to select respondents. In the first stage, four SSI schemes in the rift valley were selected purposively (Gedemso and Argeda from Oromiya; Ebala and Bedeneyalemtena from Southern Nations Nationalities and peoples

/SNNPR/ Regions). In the second stage, households from the head, middle and tail of the schemes were selected randomly, which comprises 145 users and 168 non users. Quantitative data on resource endowments and assets, average landholding size, livestock holding, incomes, expenditures and employment; demographic and social indicators like family size, dependency ratio and education level were collected from sample households through interview schedule. Qualitative data on the community perceptions about the benefit of irrigation and constraints were gathered from community representatives through focus group discussion.

Data analysis

Data was entered and analyzed using statistical package for social sciences (SPSS version 16). The descriptive analysis is based on means and standard deviations computed from the data. Independent sample t and chi square tests were used for assessing the difference between irrigation users and non-users in terms of socio-economic factors. The poverty line is measured based on cost of basic needs (CBNs) derived from the lowest income quartile and poverty indices were computed using Foster Greer and Thorbecke (FGT) formula. Foster et al. (1984) have suggested a useful general index for poverty measures. Their class of poverty indices takes the following form:

$$\rho = \frac{1}{N}\sum_{i=1}^{q}\left[\left(Z_p - Y_p\right)\right]^{\alpha}$$

Where Zp denotes the poverty line, Yi the expenditure or income of the i-th poor household (or individual), N the total number of households and q the number of households whose expenditures or incomes are below the poverty line. Thus, if α = 0, index Pα becomes: P_0 = q/N, which has been referred to as the head-count index; if α is 1, poverty gap index and if α is 2 poverty severity index.

A logistic regression model was used to analyze the impact of small scale irrigation schemes on household poverty status. Similar studies have used binomial logit model in irrigation impact analysis (Farah et al., 2001; Getaneh, 2011; Oni et al., 2011). Thus, poverty is the dependent variable, and is determined by independent variables such as irrigation use, household characteristics, asset holdings and access to services. The dependent variable is binary (1 if the household is poor and 0 if the household is non-poor). Following Gujarati (2003), the probability that the i^{th} household is poor is given by:

$$Pi = E(Y = 1/Xi) = \frac{1}{1+e^{-(\beta_0 + \beta_i \chi_i)}} \qquad (1)$$

For ease of exposition, the probability that a given household is poor is expressed as:

$$\rho_i = \frac{1}{1+e^{-(Z_i)}} \qquad (2)$$

Probability for not poor is $1-P_i$. Thus,

$$\frac{P_i}{1-p_i} = \frac{1+e^{z_i}}{1+e^{-z_i}} \qquad (3)$$

is the ratio of the probability that a household was poor to the probability of that it was non-poor. The natural log of Equation 3 is:

$$L_i = \ln\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta_o + \beta_1\chi_1 + \beta_2\chi_2 + ... + \beta_n\chi_n. \qquad (4)$$

Where Pi is a probability of being poor ranges from 0 to 1, Zi is a function of n explanatory variables (x) which is also expressed as:

$$Z_i = \beta_o + \beta_1\chi_1 + \beta_2\chi_2 + ... + \beta_n\chi_n. \qquad (5)$$

β_o is an intercept $\beta_1, \beta_2, ...\beta_n$ are the slopes of the equation, L_i is log of the odds ratio, which is not only linear in Xi but also linear in the parameters, X_i is vector of relevant independent variable.

If the disturbance term (Ui) is introduced, the logit model becomes:

$$Z_i = \beta_0 + \beta_1\chi_1 + \beta_2\chi_2 + ...\beta_n\chi_n + \cup_i \qquad (6)$$

RESULTS AND DISCUSSION

It presents respondent's demographic profile, community's perspectives, and the role of irrigation use on production, employment, income, asset endowment, consumption and poverty.

Demographic profile of respondents

In this study, 145 irrigators and 168 non irrigators were compared. Table 1 indicates that the proportion of women irrigators was 19.3%, which implies that women's access to irrigation is by far below that of men. The report of Kinfe et al. (2012) also revealed that women's access to irrigation is limited in Northern Ethiopia. The minimum and maximum age limits are 18 and 82 respectively with mean age of 40. There seems no disparity by age towards accessing irrigation and there is a tendency for young farmers to engage in irrigation farming. Education is one of the most pertinent factors that affect human behavior. About 37% of respondents are illiterate; of which 37.8 and 36.3% respectively are irrigation users and non-users. This means that 37% of the respondents cannot read and write and there is no wide variation in the education attained between irrigation and non-irrigation households. The rest 23.5, 29.3 and 10.2% completed 1 to 4, 5 to 8 and 9 to 12 grades respectively (Table 1). The average household size was 6.6 persons, with 1 and 13 being the minimum and the maximum respectively. There is also no significant variation with respect to household size and number of dependents between irrigation users and non-users.

Community perspectives on the role of irrigation

The investigated community has perceived that SSI is a

Table 1. Socio-demographic profile of respondents.

Gender	User	Non user	Total		
Female	19.3	12.5	15.7		
Male	80.7	87.5	84.3		
Age				**Minimum**	**Maximum**
Mean	40.4	39.6	39.98	18	85
Standard deviation	11.82	11.87	11.3		
Education level				**0**	**12**
Illiterate	37.8	36.3	37.0		
1-4 grade	22.4	24.4	23.5		
5-8 grade	27.3	31.0	29.3		
9-12 grade	12.6	8.3	10.2		
Household size				1	13
Mean	6.7	6.57	6.6		
Standard deviation	2.55	2.28	2.4		
Dependency ratio				**0**	**10**
Mean	1.08	1.04	1.06		
Standard deviation	1.14	0.87	1.00		

pillar to improve rural livelihoods. According to focus group participants, almost all of the irrigation users in their specific localities have improved their livelihoods as a result of irrigation. Many of irrigation users have constructed corrugated iron sheet house, been able to educate their children, become food self-sufficient either through own production or purchasing from market, started local investment like petty trading; grain mill factory, buying vehicle (*Isuzu*) for transport facility etc. According to most focus group discussants, the proportion of irrigation users with investing in local business like rural shops, petty trades; did not exceed 25% of irrigation beneficiaries. The rest majority were unsuccessful due to lack of capital, limited potential and low bargaining power. This indicate that majority of the users are not gaining the intended benefit for one or another reasons. Furthermore, lack of efficient market and frequent fall of commodity price are mentioned as the major sources of failure. In addition, during the focus group discussions, we have investigated that there are several challenges in water use administration. There are no strong and functional water user associations (WUAs) in all of the investigated schemes. The WUAs have a weak coordination skill to solve scheme related problems like water theft and conflict between users.

The role of irrigation in production, employment and poverty

Irrigation may lead to poverty reduction via increased yields, increased cropping areas and higher value crops, by these means raises employment (directly of farm workers, indirectly of other workers if wages are bid up). Increased mean yields can mean increased food supplies, higher calorie intakes and better nutrition levels. This study investigated that there were significant differences in levels of production, employment, asset endowment, consumption, and income between irrigation users and non-users as follows:

Irrigation increased production

Comparative yields analysis by crop type could not be done because of lack of uniformity in the use of inputs. However, gross yield for major crops by access to irrigation was presented in Figure 2.

As expected, irrigation use has significantly contributed towards achieving household's goal of increased production and this result is similar to other reports (Getaneh, 2011). Data analysis of major cereals and horticultural crops showed that mean crop yield per household for *teff*, maize, green pepper, potato, tomato, red onion, cabbage and barely is highest for irrigation users than non-users. This evidence has ensured that irrigation use is a guarantee for increased food supply and ensured food security. Some crops like tomato, onion, pepper and cabbage are only grown by those households with access to irrigation. This is also an indication of the fact that irrigation use increases cropping diversification and intensity.

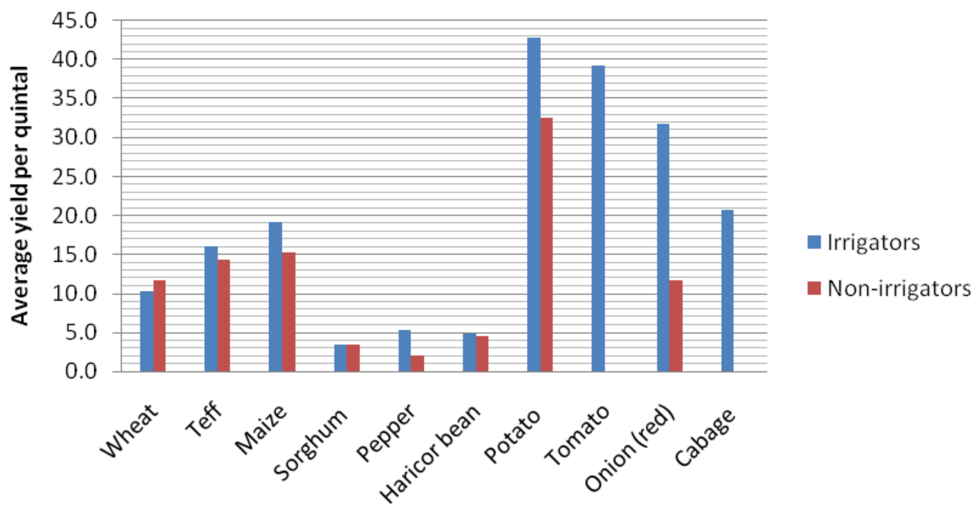

Figure 2. Average crop yields per quintal per household (1 quintal = 100 kg).

Table 2. Labor hour and cost by irrigation use.

Average labour hour	Irrigation use	Mean	Standard deviation	t/p
Plowing	User	76.90	84.38	8.464/0.000***
	Non user	21.71	25.61	
Weeding	User	90.79	116.18	7.085/0.000***
	Non user	26.51	38.11	
Harvesting	User	87.31	97.74	7.445/0.000***
	Non user	28.33	39.66	
Trashing	User	70.98	76.12	7.113/0.000***
	Non user	24.23	38.81	
Labor cost per ha in Ethiopian Birr (ETB)	User	535.94	800. 95	2.988/0.003***
	Non user	305.92	495.36	

***, Significant at less than 1% probability level, SD; standard deviation.

Irrigation enhanced employment opportunities

Conceptually, among the many benefits of irrigation, employment generation is crucial. The beneficiaries have shifted from once a year (rainy season) to two and three harvests and labor use efficiency were improved due to irrigation. Table 2 shows that mean hour invested on irrigated farm is significantly higher than the rain fed only farm for all activities from plowing to trashing. Similarly, the average labor cost (calculated only for hired labor) for irrigation user is more than double of the non-user households. This implies that, irrigation is a stimulus to increased employment opportunity. Most smallholder activities all draw from the same family labor sources, supplement for certain operations by neighbor help and casual wage labor. The development of the irrigation schemes has created job opportunities for the nearby farmers in addition to the irrigation users in the traditionally slack dry times.

Irrigation increased income

It is expected and revealed that irrigation would improve income earning (Getaneh, 2011; Hussain, 2004; Kinfe et al., 2012). Similarly, irrigation beneficiaries earned an annual mean income of 10161.5 Birr per household, which is 33.6% higher than that of non-users. Irrigation use has a positive impact on households earning from crop, and livestock, while the value of off farm income

Table 3. Income earned by households with and without irrigation.

Income source (ETB)	Irrigation use						t
	User		% share	Non user		% share	
	Mean	Standard deviation		Mean	Standard deviation		
Livestock	1451.6	2826.6	13.5	1070.2	2150.3	13.7	1.324
Crop	8138.5	6012.1	76.0	5520.9	3879.3	70.5	4.635***
Off farm	1125.2	2549.6	10.5	1234.7	2239.9	15.8	-0.0.4
Total	10161.5	5612.7	100	7606.0	4280.6	100	4.562***

***Significant at less than 1% probability level.

Table 4. Asset endowments by households with and without irrigation.

Assets owned	Irrigation use	Mean	Standard deviation	t
Total value of asset (ETB)	User	2060.16	6510.74	2.500**
	Non user	597.58	3450.67	
Total size of plots (ha)	User	1.50	1.00	3.84***
	Non user	1.12	0.76	
Total livestock (TLU)	User	5.45	3.80	2.008/**
	Non user	4.55	3.88	

***, ** Significant at less than 1 and 5% probability levels.

earning was higher for non-users. Close examination of the data exhibit that remunerative off farm income sources like cart and trade were the results of irrigated agriculture whereas inferior livelihood activities like fire wood and charcoal selling, and causal work were dominated by non irrigators. This finding is similar to the findings of Getaneh (2011) which states small-scale irrigation has a negative impact on non-farm incomes. Income share by category indicate that 76 and 70.5% of total incomes for users and non-users respectively come from crop, while the rest from livestock and off farm activities. Irrigators earned 47.4% higher than that of non-irrigators from crop alone and this difference is statistically significant (Table 3).

Irrigation improved asset endowments

Irrigation allows a greater area of land to be used for crops and asset ownership increases with access to irrigation (Hussain, 2004). This study paid attention to the basic production resources like land and livestock, as well as total value of household goods (farm tools and furniture's) estimated at purchase price. Accordingly, the value of asset owned by irrigators is three fold of non irrigators. Access to irrigation increases mean land ownership by 0.38 ha and it enhance livestock ownership by a factor of 0.91 tropical livestock unit (TLU) (Table 4).

Irrigation improved household consumption

In order to measure the impact of irrigation on household consumption, expenditure pattern was used as a proxy indicator for standard of living. This usually refers to the ability of the household to produce/purchase a basket of goods containing the minimum quantity of calories and non-food commodities. Accordingly, the average consumption expenditure per adult equivalent (AE) per annum for irrigators is more than twofold of non irrigators. Similarly, the value of home consumption, food and non food expenditures are significantly higher than that of non-users. For instance non irrigators consumption from own production is only about 51% of that of irrigation beneficiaries. This indicates that access to irrigation improves food security through home consumption by increasing the frequency of production. It also enhances the capacity to access food through purchase by 50.7%. Thus, there is a positive correlation between nutritional status and irrigation access. It has also a positive impact on non food consumption. The non food consumption value of non-users was 60.8% of that of irrigators (Table 5). Thus, this study could argue that irrigation access improves overall welfare of rural households through

Table 5. Expenditure pattern of households with and without irrigation.

Expenditure (ETB)	User		Non user		F	P
	Mean	Standard deviation	Mean	Standard deviation		
Food	3467.8	2965.2	1715.6	1813.6	40.934	0.000***
Non food	2540.6	4725.5	1546.5	2052.2	6.073	0.014**
VOC	5968.9	19828.1	3047.1	2660.7	3.57	0.060*

***, **, * Significant at less than 1, 5 and 10% probability levels; VOC, value of own consumption.

Table 6. Poverty status and indices by access to irrigation.

Irrigation use	Poverty status				X^2	P
	Non-poor		Poor			
	N	%	N	%		
User	130	89.7	15	10.3	**51.152**	**0.000*** **
Non user	88	52.3	80	47.6		
Total	218	69.6	95	30.4		

Irrigation use	Head count index (α = 0)	Poverty gap (α = 1)	Squared poverty gap (α = 2)
User	0.10	0.042	0.02
Non user	0.48	0.17	0.09

***Significant at less than 1% probability level.

improved food access, non food consumption and asset accumulation.

Irrigation contributed to poverty reduction

Local poverty line: There are many different concepts of poverty in various disciplines. It has been increasingly realized that poverty is a multidimensional concept, extending from low levels of incomes and expenditures to lack of education and poor health, and includes other social dimensions such as powerlessness, insecurity, vulnerability, isolation, social exclusion and gender disparities. This study made use of cost of basic needs to set poverty lines. The first activity in this approach is to identify a bundle of food and non food items usually consumed by the 20% lowest income quartile and estimating the cost of meeting this need (Ravallion, 1994). Accordingly, the food poverty line (FPL) for this study is 1016.49 ETB per AE per year, whereas the total non food expenditure is 310.64 birr per AE per year which covers clothing, medication, tax and social obligation costs. Adding all these expenditures from the lowest income group will make the total poverty line beyond which an individual is considered to be non-poor. Thus, the poverty line was 1016.49 birr per AE per year.

Poverty status and indices by access to irrigation: Table 6 shows from the 313 sample households, 30.4% of them are poor, which accounts for 47.6% of non-users and 10.3% of the users, which implies that poverty incidence is 37.3% higher in rain-fed only farm than irrigation. The rest 89.7% of the users and 52.3% of non-users respectively are non-poor. This confirms that irrigation development is a key for poverty reduction. The fact that 10.3% of irrigation beneficiaries being poor entails, on one hand access to irrigation is a necessary, but not a sufficient condition for poverty alleviation, and on the other hand, poverty may be adversely affected where irrigation is mismanaged leading poverty. In addition, one has to understand that poverty is a complex phenomenon. The study showed that 48 and 10% of the non user and user households respectively were living below the locally determined poverty line on the head count basis. The corresponding poverty gap by irrigation use was 0.042 and 0.17 for user and non user, respectively; whereas poverty severity index was 0.02 and 0.09 for users and non-users respectively (Table 6). Thus, poverty is more severe and widespread among non irrigators than irrigators.

Determinants of poverty: Binomial logit model was used to identify factors pushing in or pulling out households of poverty. As the major focus of this study aims to investigate the role of irrigation in poverty reduction; poverty is considered as the dependent variable of the model, while the variables are listed in

Table 7. Binomial logit model result for determinants of poverty.

Irrigation user	B	Standard error	Wald	Significant difference	Exp (B)
	-0.572	**0.289**	**3.900**	**0.048****	**0.565**
Age of head	0.045	0.014	9.845	0.002***	1.046
Household size	0.521	0.095	29.847	0.000***	1.683
Dependency ratio	0.267	0.140	3.636	0.057*	1.306
Farm size	-0.859	0.230	13.967	0.000***	0.424
Livestock holding (tlu)	-0.153	0.063	5.893	0.015**	0.858
Education of head	0.098	0.048	4.185	0.041**	1.103
Distance to market	-0.017	0.038	0.201	0.654	0.983
Constant	-3.993	0.812	24.157	0.000***	0.018
Pearson X^2	5.109***				
-2 Log likelihood	308.208				
Sample size	313				

*******, ******, ***** significant at less than 1, 5 and 10% respectively.

Table 7 including irrigation use are independent variables that determine the likelihood of being poor or not. Before running the model, the study used the variance inflation factor and contingency coefficients to check for multicollinearity among continuous and discrete variables respectively. According to the test result, multicollinearity was not a serious problem among the continuous variables. However, there is strong association between irrigation use and sex of household head. As a result, sex of head was removed from the model. The regression classification table revealed that binomial logistic model managed to predict 82.6% of the responses correctly. The model chi-square statistic for Hosmer and Lemeshow test also showed the chi-square value was found to be 5.025 and the overall model was found non-significant at 0.755 levels stating that the model adequately fits the data (Table 7).

Interpretation of significant variables

The results of binomial logit verify that most of the explanatory variables in the model have the signs that conform to our prior expectations, except education of head. Thus, irrigation use with the odds of being poor over non-poor was negatively correlated and significant. This means the probability of being poor decreases by a factor of 0.565 for those households with access to irrigation keeping other factors constant. This suggests that the probability of being poor decreases if one has access to irrigation. This finding is incongruent to the findings of Ayalneh and Korf (2009) and Getaneh (2011). Hussain (2004) also noted that irrigation contributes to poverty alleviation both directly and indirectly. It may lead to poverty reduction via increased yields, increased cropping areas and higher value crops and raising employment opportunities (FAO, 2003). Among demographic factors, age of household head was positively and significantly related to the probability of being poor; hence, old age is the cause of poverty. That means as age of the household head increases, this contributes to household poverty. The probable reason is that with age asset depletes for example land decreases upon inheritance to children. The results are consistent with the study of Gyekye and Akinboade (2001) and Sabir et al. (2006). But, it is against the findings of Ayalneh and Korf (2009); which stated that older households have greater likelihood of being non-poor. Household size positively affected the probability of a household to be poor; a unit increase in household size increased the probability of being poor by 1.683. This finding is consistent with that of Alemu et al. (2009) and Ayalneh and Korf (2009).

Similarly, dependency ratio was found to positively and significantly affect the probability of being poor by a factor of 1.3. This ratio allows one to measure the burden weighing on members of the labor force within the household. It is also in agreement with findings of Gyekye and Akinboade (2001), which stated that poverty is more likely to be associated with large households with a high dependency ratio. As expected, ownership of land and livestock showed strong negative effects on the probability of households to be poor. A unit increase in landholding and livestock holding increased the probability of a household being non-poor by 0.4 and 0.8 respectively. This finding is also similar to that of Alemu et al. (2009) and Ayalneh and Korf (2009). Contrary to expectation education of head was found to influence poverty positively and significantly at P<0.05. It seems illogical, but the possible reason is that the educational attainment of sample households was below the level that guarantee employment and it did not allow them to generate income as a result of their education. People who have obtained jobs in the urban areas are in general better educated (at least completed 10th grade level), which only few of the sample households achieved. Thus, unlike some findings of Ayalneh and Korf (2009), educational level of household heads was not found to have a negative effect on poverty.

CONCLUSION AND RECOMMENDATION

This study assessed the role of small scale irrigation on poverty based on 313 households of the rift valley river basin. The roles that SSI played were seen in terms of increasing production, income, assets, and employment opportunity, as well as poverty reduction. Both the descriptive and econometric analysis showed that irrigation use has a positive effect on farm production, income, asset endowment, and employment opportunity and poverty reduction.

Thus, it is pertinent to conclude from this study that irrigation development helps to increase household income and reduces the incidence of poverty at the household level. It can benefit the poor through raising yields and production and nonfarm employment. However, the economic performances of irrigation systems in the study areas were constrained due to imperfect market structure and financial shortages.

The following recommendations were given based on the findings of the study. Water users associations should be organized and empowered in order to improve the performance of SSI schemes; simultaneously, cooperatives should be encouraged and empowered in order to solve the marketing constraints of members. In this regard, agricultural extension should be improved and include market information and business training. The most crucial ones are linking the traders and the producers to work as partners. Institutional support towards capacitating, training, and coordinating rural cooperatives would play an inevitable role in enhancing the effect of irrigation on poverty reduction.

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