ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

Determinants of Small Scale Irrigation Use and Its Implication on Poverty Reduction: Empirical Evidences from Bogena River Catchment in Awabel District, East Gojjam, Ethiopia

By

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July, 2019

Addis Ababa, Ethiopia

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A Thesis Submitted to Center for Environment and Development Studies in Partial Fulfilment of the Requirements for the Degree of Masters of Science in Water Resource Management

By

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July, 2019

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DECLARATION

I declare that this thesis is submitted for the partial fulfillment of the degree of Master of Science in Water Resource Management. It is my original work and has not been presented for a degree in any other university and all sources of materials used for this thesis have been properly acknowledged and references are listed at the end of the main body of the thesis and cited using APA system.

Student Name Banchaymolu Terefe Temesgen

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Place: Addis Ababa University, Center for Environment and Development studies

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This is to certify that the thesis prepared by Banchaymolu Terefe, entitled:
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Acronyms

ADOA	Awabel District Office of Agriculture
CSA	Central statistical Agency
Bm	Billion meter
DA	Development Agent
ETB	Ethiopian Birr
FGD	Focused Group Discussion
GDP	Growth Domestic product
Ha	Hectare
IWRM	Integrated Water Resource Management
Km	Killometer
MOA	Ministry of Agriculture
MOWR	Ministry of Water Resource
MOWIE	Ministry of Water Irrigation and Energy
MOFED	Ministry of Finance and Economic Development
SPSS	Statistical Package for Social Science
SSI	Small Scale Irrigation
UNDP	United Nation Development Program
USD	United State Development
WSDP	Water Sector Development Program

Abstract

Small scale irrigation strategy is important to reducing risks associated with both rainfall variability, production of different crops twice or three times within a year, increasing income of rural farm-households and also reduce the poverty status of farm household. The study was conducted in East Gojjam, Awabel District on Sekute Enegatera kebele. The aim of this study was to identify the determinants of small scale irrigation use and its implication on poverty reduction. The required data set for the study were gathered primarily through survey method from 168 randomly selected sample households both from irrigation users and non-users (84 for each). To collect the required data several methods like interview schedule, focus group discussions and key informant interviews were used. The secondary data was collected from various documents. Descriptive statistics, inferential statistics (chi-square and independent t-test) and econometric model analysis were used to analyze quantitative data. As the binary logistic regression model result indicates, Eight variables were found to be significant namely Age, access to training on irrigation, access to credit, land holding size, family labor force, Market access and oxen ownership had significant and positive effect on the use of irrigation water at less than 5% probability level. While, distance from the river and terrain of farming land had significant and negative effect on the use of irrigation water at 5% and 10% significant level. Access to irrigation increases the opportunity for crop intensity and diversification, increase employment opportunity, reduce indebtedness, improve household income and reduce household poverty. In the study area the poverty gap of non-user was higher than that of irrigation user. Governmental and non-governmental organizations should give emphasis on provision of training to create awareness and skill about benefit gained from irrigation, irrigation technologies and also how to increases their access to use irrigation water in the study area.

***Keywords**: Small Scale irrigation, poverty Reduction and Logit model*

CHAPTER ONE
Introduction

1.1. Background of the Study

Ethiopia is the second most populous country in Sub-Saharan Africa with a population of 82.1 million (CSA, 2012). The country has a long history, mosaic of people and diverse culture. The country has reasonably good resource potential for agriculture development, endowed with rich biodiversity, water resource, minerals etc. Yet, it is faced with complex poverty, which is broad, deep and structural (MOFED, 2010). Most of the Ethiopian population lives in rural areas and the livelihood of the greater majority of this is based on rainfed agriculture that is subject to highly irregular rainfall pattern with detrimental impact on agricultural production (Hamda, 2014).

Notwithstanding agriculture have its own economic and social benefits, production of different agricultural crops in the country is mostly on a small scale and average crop yield is very low (Kalkidan *et al*., 2016).Major constraints to agricultural growth of Ethiopia are population pressure coupled with the dominance of the use of traditional agricultural production technology, including traditional farm tools and farming practices, low application of modern inputs like improved seeds and fertilizers and poor animal breeds. However irrigation supports the process of transforming traditional subsistence agriculture in to market-oriented production of high value crops (Hamda, 2014).

Ethiopia endows water resources which have 12 river basins with an annual runoff volume of 122 billion m3 of water and an estimated 2.6 - 6.5 billion m3 of ground water potential, which makes an average of 1575 m3 of physically available water per person per year (Awulachew *et al*., 2010).

However, out of 4.3 million hectares of irrigable land only 5% is underutilization in the country. This shows indirectly that most of the water resource of Ethiopia is underutilized though irrigation agriculture is taken as a main strategy to tackle the problem of the growing

demand for food crop production in Ethiopia. The implementation of irrigation development schemes is one of the most effective ways to reduce poverty and promote economic growth. These schemes raise crop production through enhanced yield, acreage and number of cropping cycles per year, as well as decrease the risk of crop failure (Seleshi et al. 2010).

Water resource management in agriculture is a critical contributor to the economic and social development of Ethiopia. If successful, irrigation in Ethiopia could represent a cornerstone of the agricultural development of the country, contributing up to ETB 140 billion to the economy and potentially moving up to 6 million households into food security (Awulachew et al., 2010).

According to MoA (2011) irrigation agriculture, particularly the smallholders has significant importance to raise production to reach food self-sufficiency and to reduce poverty at household level in particular and the country at large. The irrigated agriculture also play a vital role in supplying sufficient amount and the required quality of raw materials for domestic agro-industries and increase export earnings.

SSI practice is an important strategy in reducing risks associated with both rainfall variability, production of different crops twice or three times within a year, increasing income of rural farm-households and also reduce the poverty status of farm household. In attempting to do so, Ethiopia has yet developed and used not more than 5% of the irrigation potential (Awulachew, *et al*., 2010; Kalkidan, *et al*., 2016). Even if the country has its own irrigation potential, there are major limitations that constrained the development of the irrigation sub-sector are: (i) Agriculture is subsistence and predominantly based on traditional farming systems;(ii) Inadequate improved agricultural inputs;(iii) Limited access to improved irrigation technologies;(iv) Inadequate trained human power;(v) Inadequate extension services and limited availability of capital;(vi) Absence of appropriate institutions at different levels responsible for the promotion, planning and development of irrigated agriculture and environmental constraints,(vii) Inadequate information system on agricultural water management and irrigation development (MOA, 2011).

There is a strong linkage between irrigation development and poverty reduction through improving level and security of production, livelihood diversification as well as creating employment and income opportunities (Hussian and Hanjira, 2004).

Hence, the study area has its own irrigation potential, most of the smallholders used rainfed agriculture. Therefore, this study focused on the determinant factors on small scale irrigation use and also emphasizes on how irrigation contributes to poverty reduction in relation to change in income levels, employment generation, and asset building among rural communities in East Gojjam, Awabel District Sekute Enegatera Kebele using Bogena River Catchment as a case study. According to ADOA, (2019), small-scale irrigation is being practiced in the study area since 1998 E.C. Cognizant of this fact, farmers in Awabel District has been constructing different small-scale irrigation schemes with the objective of increasing agricultural production and productivity to improve the living standard of the farming communities and to reduce dependency on rainfall (ADOA, 2019).

1.2. Statement of the Problem

For a country like Ethiopia which is struggling with burgeoning population while the subsistence rainfed agriculture is under the mercy of inconsistent rainfall, water resource development is believed to have an imperative role in the agricultural, socio-economic and industrial development (Abebaw and Mesfin, 2016). According to Lipton *et al.,* (2004) irrigated agriculture can reduce poverty through increased production, income and reduce food prices, that helps very poor households to meet the basic needs by improving their overall economic welfare, protect them against risks of crop loss due to insufficient rain water supplies and promote their use of yield enhancing farm inputs which in the long run enable them to move out of the poverty trap. Hence, though successive regimes of Ethiopia have attempted to boost irrigated agricultural production through irrigation development, the country still could not exploit its irrigation potential efficiently and effectively. Instead, it is highly depend on rain fed agricultural production system (MoA, 2011).

According to Woldegebrial *et al*., (2015) irrigation agriculture are many problems such as lack of effective and efficient use of available irrigation water due to inadequate knowledge about the use of irrigation, shortage of labor force, limited access to technology, poor time

resource management system, and poor experience of farmers to adapt irrigation farming etc. at the irrigation scheme. Similarly Even if the study area has its own irrigation potential, most of the households of the irrigation scheme have not use the irrigation opportunity and many of them still depend on rainfed agriculture rather than being the irrigation scheme beneficiaries do to the presence of those listed factors.

In several researchers, such as Gebremeskel (2013), Hagos *et al*.,(2009), Bacha *et al.*,(2011), Gebregziabher *et al*.,(2012)., and Woldegebrial *et al*.,(2015) have already studied these supply side initiatives of introducing small scale irrigation , improved technologies and major constraints on participating in small scale irrigation. Those studies also report that, irrigation has significantly increase farm production input compared to rainfed agriculture. This study emphasis on determinants of using SSI and its contribution on production levels of users and non-users, beyond this the study also evaluate the poverty status of irrigation users and non-users.

Awabel is one of the districts located in Amhara region and the district has above 7265 hectare irrigation potential, but only 2440 hectare of small scale irrigation was being irrigated. Their living standard of the community is subsistence (ADOA, 2012). The existing potentials and efforts to increase income level of the rural households are known least. The knowledge regarding the contribution of irrigation to household income as well as its effect on poverty reduction is insufficient in the study area. Therefore, this study was conducted to identify the determinant factors that influence the use of irrigation water and its implication on poverty reduction.

However, the study district lacks in-depth studies to identify the determinant factors that influence the use of irrigation water. The issue is also not well supported by complete research. The contribution of irrigation on household production level is not well known and to what extent the households using irrigation are better off than those who depend on rain-fed agriculture in the study area. Therefore, the main motivation behind this study is to explore the determinant factor that hinder small scale irrigation water use and whether irrigation use in the study area is making positive change on reducing household poverty or not.

1.3. Research Questions

This study provide answers for the following three questions:

1) What are the determinant factors on the use of small scale irrigation in the study area?
2) What are the implications of small scale irrigation use on poverty reduction among rural households?
3) What are the significant challenges that affect small scale irrigator households?

1.4. Objectives of the Study

The main objective of this study was to examine the determinants of small scale irrigation use and its implication on poverty reduction. The specific objectives include the followings;

1) To investigate the determinant factors affecting small scale irrigation use in the study area.
2) To evaluate the implication of small scale irrigation on poverty reduction among smallholders.
3) To assess the challenges faced by small scale irrigator households.

1.5. Significance of the Study

The findings of this study are expected to benefit local governments and development practitioners in particular, policy makers in general in terms of improving the knowledge base for impact of irrigated agriculture on enhancing household income as well as its contribution to reduce poverty. Similar studies conducted by Tizita. (2017) stated that on top of this, the findings of the research work give insight for researchers and students interested in similar research theme for further investigation in other areas.

1.6. Scope and Limitation of the Study

This study was conducted on selected kebele of the District (i.e. Awabel) in East Gojjam, Amhara Region with the concerned issue on the determinants of small scale irrigation use and its implication on poverty reduction in Sekute Enegatera Kebele by taking sample from those selected households from the whole community by using Bogena River Catchment. Thus, the study result was not reflect the entire Amhara region of small scale irrigation users and non-users. The study was also emphasizes on only irrigation water use the other water use such as industrial water and domestic water use was not included under this study; other types of irrigation types such as medium and large scale irrigation were not included in the study. The researcher faced a number of problems during data collection period. One of the main problems was inaccessibility of respondents because they engaged in different social duties and marketing activities. Moreover, inaccessibility of roads in the community has constrained the transportation facilities and the researcher was enforced to walk longer distance on foot. This made the data collection process difficult and longer than it was planned.

1.7. Organization of the Paper

This research thesis contains five chapters. The first chapter of the paper highlights the background of the study, statement of the problem, objectives of the study, significance of the study, scope and limitation of the study and operational definition of terms. The second chapter of the study addresses some empirical evidences about the subject under study and conceptual framework of the study. The third chapter deals Research methodology of the study while the fourth chapter explains the result and discussion of the study and finally conclusion and recommendation clarifies on the fifth chapter of the research.

CHAPTER TWO
Literature Review

2.1. Operational Definition of Terms

Poverty: is lack of basic needs and services such as food, clothing and place to sleep and rest after the day's work (UNDP, 2006).

Smallholder Farmers: The farmer with limited land availability, small farm sizes and unable to satisfy their own needs are known as smallholder farmer. Whiles other concept may outline a broader view of it as "resource-poor" farmers: e.g. those farmers with limited capital (including animals), fragmented assets, and largely low market orientation; other poor land quality and limited access to technologies such as irrigation, farm enterprises primarily dependent upon family labor, and limited access to inputs(Letitia, 2012).

Small Scale Irrigation: The artificial application of water to small plot of land ranging from 0.2 to 0.5 ha, comprising a small number of farmers containing 200 users, using relatively small reservoirs- rivers, dams or a cluster of wells controlled by the farmers using technology. In highland areas like Ethiopia, where water is delivered through gravity, small-scale irrigation schemes concern the upgrading of irrigation works, where the simple diversion structures, micro dams constructed by traditional communities with local means such as stone and brushwood (Gebremeskel, 2013). It is a means by which agricultural production can be increase to meet the growing food demand through increasing agricultural yield, increase the productivity of arable land and increase cropping intensity (Humda, 2014).

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.

Cross sectional study design: Research study being conducted at a point in time at a geographical location or for a group of people.

Binary logistic regression: predicts the probability that an observation falls into one of two categories of a dichotomous dependent variable based on one or more independent variables that can be either continuous or categorical.

2.2. Theoretical Review

2.2.1. History of Irrigation Development and Water Resource in Ethiopia

Ethiopia is endowed with plentiful amounts of water resources potential. However, the backbone of Ethiopian economy, Agriculture, is highly rainfall dependent and the energy source relays on fuel wood. Even though the country has enough amounts of water resources potential, clear current figure of water resources potential especially in ground water part, utilization constraints and future water resources utilization opportunities is not clearly known. Ethiopia is believed to have the total potential of 3.7 million hectares of land that can be developed for irrigation through pump, gravity, pressure, underground water, water harvesting and other mechanisms (Awulachew et al., 2007).Out of the total potential, about 10 to 12% of this potential is put under irrigated agriculture (both traditional and modern irrigation systems). Irregular place to place and time to time sharing of major rivers and rain fall, cross boundary nature, topographic features of the country, technical and financial challenges are among main utilization constraints (Dessalegn, 2018).

As shown in Table 1 the country owns twelve major river basins, which form four major drainage systems. These drainage basins are Nile basin (including Abbay or Blue Nile, Baro-Akobo, Tekeze and Mereb) covers 33 percent of the country and drains the northern and central parts westwards; The Rift Valley (including Awash, Danakil, Omo-Gibe and Rift vally Lakes) covers 28 percent of the country and consists of a group of independent interior basins extending from Djibouti in the north to the United Republic of Tanzania in the south, with nearly half of its total area being located in Ethiopia; The Shebelli-Juba basin (including Wabi-Shebelle and Genale-Dawa) covers 33 percent of the country and drains the southeastern mountains towards Somalia and the Indian Ocean; The North-East Coast

(including the Ogaden and Ayisha) covers 6 percent of the country. Most of the rivers in Ethiopia are seasonal and there are almost no perennial rivers below 1500 m altitude. About 70 percent of the total runoff takes place during the period June-September. Dry season flow originates from springs which provide base flows for small-scale irrigation (FAO, 2016).

Due to evaporative losses, not all flow reaches adjoining countries. For example, out of the 17 960 million m^3/year of the Omo-Gibe in the Rift valley only 10 000 million m^3/year arrive at the border with Kenya. Also, out of the 23 600 million m^3/year of the Baro-Akobo in the Nile basin, only 13 000 million m^3/year are seen at the border with South Sudan.

Irrigation development historically started, as a response to bad agro-climate in low rainfall areas and seasons. Irrigation development has been promoted as a means to bring about socioeconomic transformation since the Second World War (Hamda, 2014).

Irrigation has long played a key role in feeding expanding populations and is undoubtedly destined to play a still greater role in the future.

In Ethiopia, government intervention in irrigation development is a recent phenomenon, though farmers of high land area practiced traditional irrigation for centuries. Imperial government in 1950s through constructing water development projects initiated the development of water for irrigation purpose. The development has concentrated in the Awash valley as part of agro-industrial development initiative. Later it has gradually expanded to rift valley and the Wabishebele basin (Berhanu and Peden, 2002). According to Awulachew *et al*., (2010), estimate the irrigation potential of Ethiopia is 4.3 million hectares. In Ethiopia traditional irrigation schemes cover more than 138,000 hectares whereas modern small-scale irrigation covers about 48,000 hectares (Awulachew *et al*., 2010).

Table 1**:** Water Resource and Irrigation potential of river basins in Ethiopia

Basin	Type	Catchment Area (km^2)	Water Resource (Bm^3)	Irrigation potentials (ha) (Respective recent master plan studies)			
				Small scale	Medium scale	Large scale	Total
Abay	River	199,912	54.4	45,856	130,395	639,330	815,581
Tekeze	River	82,350	8.2	NA	NA	83,368	83,368
Baro – Akobo	River	75,912	23.23	NA	NA	1,019,523	1,019,523
Mereb	Dry	77,120	0.72	NA	NA	NA	
Omo – Ghibe	River	52,000	16.6	NA	10,028	57,900	67,928
Reft vally	Lake	5,900	5.56	NA	4,000	45,700	139,300
Awash	River	110,000	4.9	30,556	24,500	79,065	134,121
Genale- Dawa	River	172,259	6	1,805	28,415	1,044,500	1,074,720
Wabi– Shebelle	River	202,220	3.4	10,755	55,950	171,200	237,905
Danakil	River	64,380	0.86	2,309	45,656	110,811	158,776
Ogaden	Dry	79,000	0	–	–	–	–
Ayisha	Dry	2,223	0	–	–	–	–
Total			**123.95**				**38,00,733**

Source: IWMI (2010), MoWE and FAO (2012)

Although irrigation potential in Ethiopia is estimated at 3.7 million hectares under conventional gravity irrigation, if rain water harvesting and supplementary irrigation, ground water use, and water lifting technologies are considered, it is believed that the potential could be more than the estimated hectares (Teshome, 2006).

Irrigation development is vital for smallholder farmers' to improve their economy, create sustainable and reliable agricultural developments in Ethiopia (MoA, 2011). Similarly, make use of irrigation agriculture is going to be a means for increased agricultural production to meet the growing food demands of rapid population growth. Irrigation development in

Ethiopia can be considered as a cornerstone of food security and poverty reduction tool as it has a power to stimulate economic growth (Hagos, *et al*, 2009).

In Ethiopia, only 10% of the estimated potential irrigable land is actually irrigated and 2% of cultivated lands are irrigated (MoWR, 2002). Similarly, irrigated agriculture comprises only 3% of the total national food production (Bacha, 2011).

2.2.2. Irrigation–Poverty Linkage

Hussian and Hanjira, (2004), confirmed a strong direct and indirect linkage between irrigation and poverty. Direct linkages operate through localized benefit through which irrigation increase agricultural production and consequently reduce poverty in household level, whereas indirect linkages operate through aggregate or sub-national and national level impacts.

Irrigation enables smallholders to adopt more diversified cropping patterns, and to shift from low-value staple production to high-value market-oriented production, increased production makes food available and affordable for the poor (Asayehegn *et al.*, 2011).

As a production input in agriculture, irrigation water is an important socioeconomic ‘‘good’’, with a positive role in poverty alleviation. Irrigation water can also become a socioeconomic ‘‘bad’’ when it leads to problems such as waterborne diseases (malaria, schistosomiasis), and land degradation including waterlogging and salinity, water pollution and associated destruction of living beings and natural ecosystems (Hussain and Hanjira, 2004). Access to consistent irrigation water can enable farmers to adopt new technologies and intensify cultivation, leading to increased productivity, overall higher production, and greater returns from farming. 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 (MoWIE, 2013).

In general, access to good irrigation allows poor people only increase their production and incomes, but also enhances their opportunities to diversify their income base, and to reduce their vulnerability to the seasonality of agricultural production and external shocks. It should be noted that the poor also use water for other farm and non-farm production activities,

particularly small-scale rural enterprises such as livestock rearing, fish production, brick making and so on. These enterprises are part of the poor's livelihood strategies and contribute to poverty alleviation. Thus, access to good irrigation water can contribute to poverty reduction, and to moving people from ill-being to well-being (Petros, 2017).

According to Hussian and Hanjira (2004), There are three main pathways through which irrigation impacts poverty.

These are:-

- Micro-pathway: Through increasing returns to physical, human, and social capital of the poor households (productivity and distribution pathway);
- Meso-pathway: Through integrating the poor into factor-product and knowledge/information markets (market participation pathway);
- Macro-pathway: Through improving national growth rates and creating second-generation positive externalities (growth pathway).These pathways are very much interlinked. What happens on one particular pathway does have impacts on others**.**

2.2.3. Implications of Small Scale Irrigation on Poverty Reduction

2.2.3.1. Implication of Small Scale Irrigation on Agricultural Production Output

According to Tadesse (2017) irrigation increased agricultural production thereby improve the economic and social wellbeing of farmers. For meeting the growing demand for food in the short run and long run food security, small scale irrigation has immense contribution in achieving poverty reduction objectives. It is one of the options which increase yield, facilitate diversification, reduce rainfall risk, and create employment opportunities.

According to Letitia (2012) the first direct impact is on output levels. Irrigation boosts total farm output and hence, with unchanged prices, raises farm incomes. It was found in the study that, increased output levels may arise for any of at least three reasons. Firstly, irrigation improves yields through reduced crop loss due to erratic, unreliable or insufficient rainwater supply. Secondly, irrigation allows for the possibility of multiple cropping, and so an

increase in annual output. Thirdly, irrigation allows a greater area of land to be used for crops in areas where rain fed production is impossible or marginal.

According to Smith (2004) evidence for these effects is widespread, well documented and uncontroversial. For example, FAO suggests that irrigation can increase yields for most crops by 100 to 400%, and that higher, less risky and more continuous levels of rural employment and income result from the higher cropping intensities, yields and more intensive and higher value crops and cultivation techniques of irrigated compared to rain-fed agriculture (Smith 2004).

Hussain and Hanjira (2004), when trying to come out with the influence of irrigation on farmers output, mentioned that irrigation enables the poor and smallholders to achieve higher yields and that the productivity of crops grown under irrigated conditions is often substantially higher than that of the same crops under non-irrigated/rain fed conditions. Communications, market access and ease of transport of farm inputs and outputs are critical to achieving the full benefits of any irrigation investment. With regard to poverty dynamics, successful irrigation can lift people out of poverty and reduce seasonal vulnerability, but in the longer run farm size may become limiting and incomes may 'plateau' without further technological or institutional advance (Tesfa, 2011).

2.2.3.2. Implication of Small Scale Irrigation on Income

First and most directly, where conditions are favorable irrigation can raise the incomes of those farmers with access to irrigated land and also built asset such as house construction for rent, saving account and reduce poverty. Thus it is an important indicator of economic development and brings sustainable agriculture development (Tesfa, 2011).

Irrigation can also reduce income variance and enhance resilience to crises. As well as raising mean levels of output, wages and incomes, it can reduce the variance of these (although possibly with increased covariance). Diversification of livelihoods can also reduce income variance and improve resilience. Irrigation raises the productivity of assets; of labor, the main asset for most of the rural poor, and of land, for those with access to it. It also improves the ability of farm households to take advantage of new livelihood opportunities

such as alternative higher-value crops, intensified livestock production and other market openings. Water control in agriculture may boost productivity and incomes by ensuring adequate water throughout the growing season, contributing to higher yields and quality (higher farm-gate prices) by eliminating water deficits and providing at least a measure of drought protection; securing a crop where rainfall is inadequate or too variable. This is so because of the availability of water for supplementary precipitation. This also allows a second or even a third crop by making water available in the dry season; as well as providing a cheaper or more secure supply of fodder for livestock (although irrigation may also involve some trade-offs with livestock production) (Awulachew *eta al*.,2010).

2.2.3.3. Implication of Small Scale Irrigation on Employment

The other direct effect on poverty is via employment. There are two sources of additional demand for labor created by irrigation projects. Irrigation projects firstly require labor for construction and on-going maintenance of canals, wells and pumps etc. This is likely to be an important sector of employment for the poor, especially the landless rural poor or rural households with excess labor or seasonal excess labor. Secondly, increased farm output as a result of irrigation will stimulate demand for farm labor both within the main cropping season and across new cropping seasons, increasing both numbers of workers required and length of employment period. Rural poverty levels may therefore be reduced by increased employment opportunities (Lipton 2007).

In addition there is an effects that extend to other areas if irrigation reduce migration to urban areas, and so reduce the pool of job-seekers and relieve the downward pressure on urban wages and the upward pressure on prices of housing and other urban infrastructure (Lipton 2007).

2.2.3.4. Implication Small Scale Irrigation on Food Prices

Irrigation water is critical to poverty alleviation through increased production in rural areas so as to improve food security and alleviate poverty. The role of irrigation development is increasing food sufficiency level of households (helps to produce sufficient amount of food consumption). Irrigation has the potential of influencing poverty via food prices. If irrigation

leads to increases in staples or non-staple food output then this may result in lower prices for staples and food in imperfectly open economies or if there are significant transport costs internationally or from food surplus areas to towns or food deficit areas. Rural net purchasers of food is therefore gain from cheaper food, as will urban consumers (Belay and Beckets, 2013).

The share of food expenditure on staples and the share of expenditure on food tend to fall as expenditure rises, and the majority of the rural poor are net food purchasers, receiving large proportions of their income from off-farm employment activities. Hence the fall in the staple price is likely to be poverty reducing. However low-income and possibly poor, small-farmers in areas not affected by extra irrigation – non irrigated or already irrigated areas – may be net producers so harmed by falling prices and may even become poor, unless the increase in output offsets the price fall. Waged agricultural laborers, in addition to increased employment, will benefit from lower prices. Wage laborers will find their wage buys more food hence will benefit from falling prices, apart from employment changes (Letitia 2012).

2.2.3.5. Stabilization and Risk Reduction

By making employment and incomes more reliable (as well as higher) irrigation protects farmers from loss of assets and also prevents peasants from getting into debt traps. In a bad monsoon, while rain fed crops may fail crops irrigated using groundwater usually yield well. Even if the groundwater table falls, it can recover during a more humid period. Thus, irrigation acts as a buffer against bad years and hence the deprivation and indebtedness that these years may entail. Risk of disposing of assets such as mortgaging or selling land to buy food or meet debts, are reduced. Letitia (2012) describe how irrigation by poor families with hand pumps has prevented them from becoming landless. Irrigation also liberates people from maintaining demeaning social relations such as with money-lenders. state that “for resource poor farmers and landless laborers alike, it ceases to be so necessary to ‘touch the shoes of the rich’ as insurance against those dreaded bad seasons or bad times of a year when food runs out and loans are needed to survive. Irrigation thus supports self-respecting independence” Letitia (2012).

2.2.4. Constraints of Small Scale Irrigation

Ethiopia has abundant water resources, but its agricultural system does not yet fully benefit from the technologies of water management and irrigation. Different constraints were forwarded related with poor technology choice, too small landholdings, conflicts in water use and use rights, lack of market information and access, lack of training on irrigation technologies, lack of irrigation structure maintenance, poor linkage between research and extension services, poor infrastructures such as roads, lack of adequate credit service and extension packages. Regarding to the organizational set-up of water users association, the general assembly is the highest body in water users' association committee which makes the final decisions based on the bylaws. The executive committees were further decentralized in to three branches. These sub-executive committees comprising two members in each were in charge of control water distribution and coordination of maintenance activities and conflict resolutions. Therefore, to alleviate these constraints and utilize the opportunities towards small-scale irrigation, the concerned bodies should attempt to minimize those factors that hinder productivity of irrigation water in the study area.

Irrigation as an agricultural innovation to increase production and productivity can as well be a necessary evil such that it may not deliver proportionally greater benefits to the relatively 'rich' even when it improves the absolute position of the poor deterioration in relative poverty. Even sometimes irrigation may harm the poor and actually worsen absolute poverty (Hamda, 2014).

Irrigation may worsen absolute poverty for some if it reinforces processes of land consolidation in which poor households lose rights to land, or if it is associated with displacement of labor by mechanization or herbicide use. Poor people may be displaced by the construction of reservoirs and canals, or their livelihoods may be adversely affected by upstream or downstream impacts. Badly designed or managed irrigation can negatively impact public health and human capital through the spread of Water-borne diseases, usually with a greater incidence for the poor. The consumption linkages that are major drivers of poverty reduction are likely to be less effective when income and land distribution are highly skewed. This is because the consumption patterns of the 'wealthy' may be oriented to

imports and capital-intensive goods and services, rather than the offerings of rural non-farm suppliers. Barriers to entry in nonfarm employment and micro-enterprise can arise from ethnicity or caste, gender, skill and education levels, access to information, mobility, transaction costs and risks (Asayehegn, 2012).

2.3. Empirical Review

According to Asayehegn, (2012) irrigation development has a profound impact in alleviating poverty. Because of small-scale irrigation increases mean annual household income, irrigating households have lower probability of being poor than non-irrigating households. Irrigating households' average income is higher, while non-irrigating households' average income is 50 percent less than the average income of irrigating households (Tadesse, 2017). There is also a difference in total household consumption expenditure between the control and treatment groups (Gebrehaweria and Regassa, 2007).

According to the finding of Asayehegn, (2012) the ratio of mean income of irrigation users to non-users exceeds by 37.03% and nutritional status and standard of living of the users also increased by the same factor as income. Moreover, irrigation use greatly supports the livelihood and reduces household poverty of the users through creating employment opportunity. Irrigation use has a positive impact on households earning from crop, livestock, and provide additional income by selling maram grass from there irrigation site, this increase income as well as reduce poverty and, 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 (Eneyew et al, 2013).

With limited off-farm sources of income from irrigated vegetables are important for food security in household that undertake irrigation (Dittoh et al., 2013). Thus, the poverty prevalence in non-irrigating households is by far greater than irrigating households. In order to reduce the rural households 'poverty status, expansion of small scale irrigation by using available water resource is a crucial factor. Therefore, access to irrigation has got a significant and positive contribution to poverty reduction (Hamda, 2014).

However, Asayehegn (2012) argued that irrigation and irrigation dams have negative impact in animal production through reduction of grazing land throughout the year and lack of free communal land for movement. Moreover, it affects public health through infestation of malaria and other water borne diseases ,which enhanced their cultural heritage is waning off (less leisure time now) because farmers now stay on farms and earning high income throughout the year (Bagson et al., 2013).

Canals and schemes should be cemented for the prevention of water logging, percolation, changing farmland to swamps and proper aeration of soils. 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 (Bagson et al., 2013). According to the MoWIE (2013) and MoA (2011), the main challenges of irrigation utilization in Ethiopia especially small scale irrigation are identified as inadequate awareness of irrigation water management, irrigation scheduling techniques, water saving irrigation technologies, water measurement techniques, irrigation input, operation and maintenance of irrigation facilities.

In general, the above reviewed empirical studies revealed that, even if small scale irrigation system have its own influential factors, it is an important tools for the improvement of households' livelihood as well as poverty reduction, both in the form of liquid and tangible asset. This is also a best mechanism that leads to the use resources more efficiently.

2.3.1. Factors Affecting Small Scale Irrigation Use

Despite Small-scale irrigation has immense potential to improve the incomes of poor rural households in developing countries like Ethiopia, it is never free from problems. These problems of small-scale irrigation technology development range from individual household's biased attitudes to institutional arrangements. Accordingly, the major problems encountered in small-scale irrigation are problems related to cost, institutional problems, the policy environment, design issues, cultural factors and environmental problems (Getaneh, 2011). As study by (Gebrehiwot et al., 2015) despite, small-scale irrigation improve rural livelihood and significantly reduce poverty, there are many factors influencing small scale irrigation use, which include:

2.3.1.1. Socio Economic Factors Affecting Small Scale Irrigation Use

Social status influences one's own property. As one rises in social status or social class from the low to the middle and upper levels, he/she may feel more contented in owning a farm than renting one. Similarly, higher socio-economic individuals may own irrigation farms as a way of liberating themselves from the "bondage" of hunger and dependence on relief food supplies. Increased income is associated with increased ability to acquire property such as arable land or engage in farming. When more people in the general population experience increased incomes, it is more likely that they seek for land property such as irrigation farms (Isaac, 2012).

The perceived permanence of the incomes resulting from profitable farming is also seen to result in more people expanding their farming activities. Farm size, household size, education level, Land holding size, Livestock holding, Market access, labor force, lack of supply inputs especially late supplying means no supplying in time and infrastructure are some of the socio economic factors (Getahun, 2011).

Wealth is a key factor affecting small- scale irrigation farming. As more people become richer and richer, more of them will most likely invest in farm and land assets as forms of their wealth. They hold their wealth in the form of agricultural land for hire or farms for their families' food production needs. The ownership of' agricultural land properties is seen as socially desirable. The price of land to set up an irrigation farm or existing irrigation farms is a factor which may encourage or discourage small scale irrigation farming. Higher prices beyond the means of prospective farmers or farm owners discourage while lower prices will act to attract prospective farmers or farm owners to engage in farming (Getahun, 2011).

2.3.1.2 Institutional Factors Affecting Small Scale Irrigation Use

The constraints that discouraged farmers' involvement were among others institutional and organizational weaknesses that directed to poor irrigation management or the lack of social organization to coordinate and manage the irrigation systems. Therefore, adequate institutional and organizational development is crucial to enhance effectiveness of irrigation promotion and to ensure sustainability of the benefits of irrigation and the irrigation systems.

It has positively contributed towards increased diversification and intensification of production and livelihood improvement. (Shimelis et al, 2006).

There is an urgent need for overcoming institutional failure as it remains a prime challenge in irrigation water management. There is evidence for the need to strengthen economic capability of female-headed households through improved access to irrigation water. Problems of income inequality and poverty reduction can be tackled if such bias against female-headed households is prevented. Thus, redesigning of institutions to overcome corruption and nepotism in water allocation at community level will contribute to the sustainable management of the scheme. It will also address equity concerns which could otherwise create disincentives for labor contribution (Hamda, 2014).

As a result, irrigation investments, whether in the development of irrigation or in the performance improvement of existing systems, should not always be assumed to be poverty-reducing and that irrigation can be strongly pro-poor, neutral or even anti-poor depending on the these and the other related conditions (Hussain and Hanjira ,2004). Similarly, irrigation play a more important role in poverty reduction, creating enabling institutional and economic environments is a major prerequisite (Bacha *et al*., 2009).According Lailita (2012) there are various institution factors that hinder small scale irrigation use such as access to credit, access to extension services, irrigation water allocation and distribution procedures and practices, support measures, e.g., information, input and output marketing.

Swamikannu and Berger (2009) is trying to find the impact of credit on farm households tested credit on them. The results of their study showed that access to credit would enable households to change their land use from subsistence rain fed farming to high value crop irrigation farming. Even with 25% of interest rate, the study suggests that households apply for farm credit and expand their area under irrigation farming. The results show that access to credit would likely increase the average household income and food energy consumption. The application of mineral fertilizer (in kg per ha) could also triple with the access to credit which would help to improve the sustainability of agricultural land use in the region. The impacts of credit on welfare of the different farm types analyzed by their study revealed that access to credit could increase the income of the irrigation farm households (small dam and

big dam farms) by 56% and 82 % respectively over the baseline income level, while the income of the rainfed farm households would increase only by 22 %. The results indicate that farm households who have physical access to irrigation land would be benefiting more by availing credit than subsistence rainfed farmers. From the above empirical findings by Swamikannu and Berger it can be said that, that providing access to credit without expansion of irrigation facilities would not give the intended result of improving the livelihood of poor subsistence rain fed farmers.

The performance of the irrigation users' cooperative in managing the scheme found at low levels show a wide gap between the objective and actual implementation. Among the factors that were found to be significant are poor enforcement of rules and regulations, non-existence of water rights, limited membership which makes the implementation of collective action difficult, poor external support from the respective stakeholders, and the multifunctional nature of the organization which causes leaders not to focus on the core objectives of water management activities. Designing an appropriate local institutional arrangement according to the demand and priority of each scheme fits to minimizing the causes for institutional failure are indispensable create a sustainable local institution for irrigation management (Wotie and Hanaraj, 2013).

2.3.1.3. Environment and Small Scale Irrigation scheme

Despite the positive contribution of irrigation development for food security and poverty reduction, many irrigation schemes have been unsuccessful and even have had negative impacts. Water logging due to inefficient use of water, absence of coordinated field ditches drainage (maintenance), creates ecological and demographic changes due to favor the formation of conductive habitats for disease vectors. Pesticide residues are also the main cause for lowering the soil PH. Irrigated agriculture provides improved conditions for aquatic weeds and diseases to propagate quickly via the use of drainage water. Due to poor water management; Reduction in land productivity, increased intensity of birds and wild animals attack, erosion, and low soil temperature are some of negative impacts of irrigation (De Fraiture et al. 2009).

On the other hand availability or lack of water for irrigation is an important factor that influence irrigation farming. The distance from water source, its sustainability in water provision that determine the type of irrigation method to be used, Water scarcity, poor water quality especially as related to sediment concentration structure of land distribution, inefficient water management resulting in water wastage, water logging and unsuitability of farming land for irrigation activity are some of environmental factors influencing the development of small scale irrigation (Bacha *et al.,* 2011).

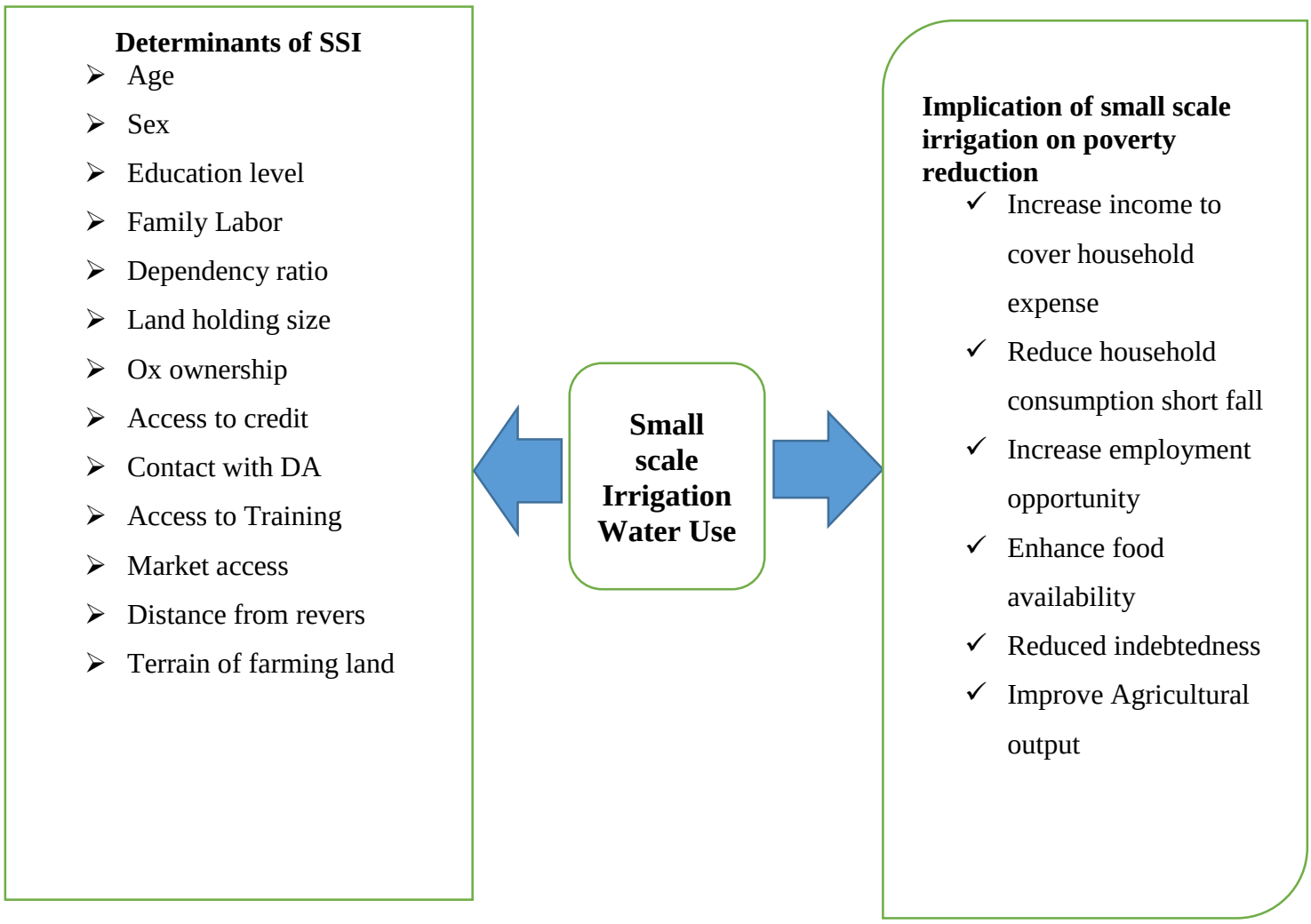
2.4. Conceptual Framework

Irrigation agriculture has good production, income generation, and poverty reduction, employment opportunity in arid and semi-arid areas. The degree of income generation potential of irrigation is greatly determined by the type of crop grown under irrigation, access to markets and institutional and policy support measures.

It is impossible to generalize that only accessing irrigation water by rural poor solves the problems of income shortage. In small scale irrigation, an institutional system of collective action was imposed. The social and institutional arrangement and dimensions such as land tenure and exchange, accessing market and sharing of water, policies and other resources that affect directly or indirectly the income of rural household were found to be great importance in the domain of the irrigation scheme (Hamda, 2014).

The following simple conceptual framework is developed to show the factors influencing small scale irrigation and its implication on poverty reduction among farm households. The figure below shows conceptual framework of this study.

Figure 1: Conceptual framework of the study



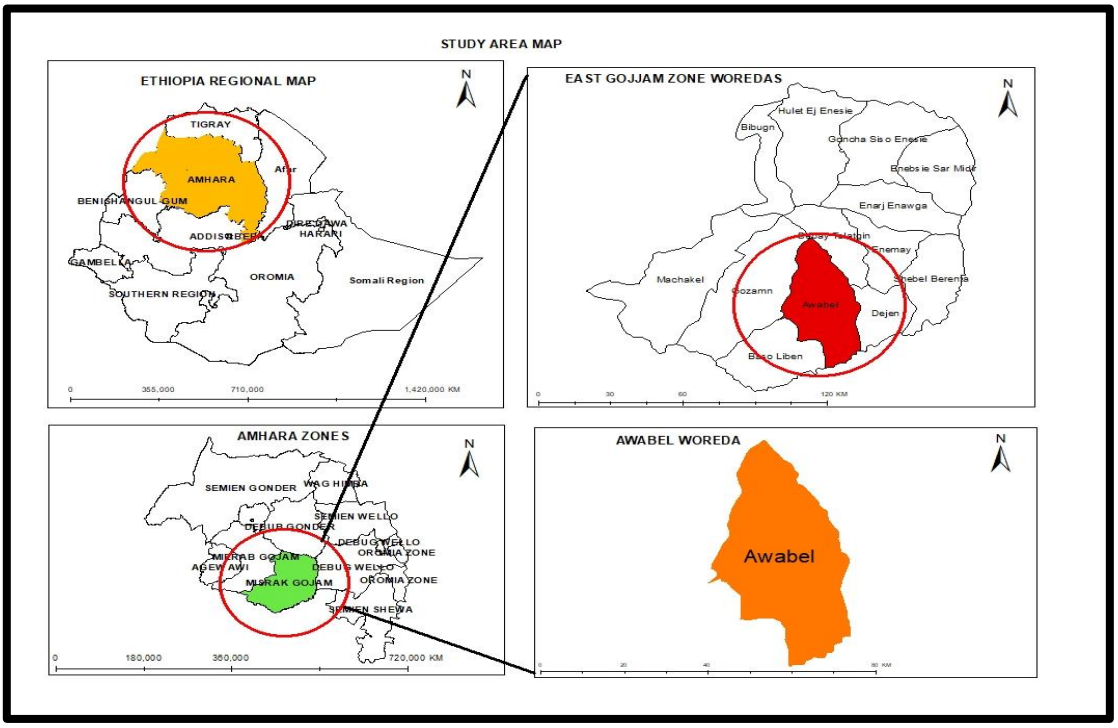
Cc: Banchaymolu, 2019

CHAPTER THREE
Research Methodology

3.1. Description of the Study Area

This study was conducted in Awabel woreda East Gojjam zone, Amhara Regional state. Awabel Woreda is found geographically located in $10^0$56‘240‘‘N longitude, 37^0 56‘240‘‘E latitude and altitude of 2290 m above sea level. Which is bordered on the south by Abay River, on the west by Aneded, on the Northwest by Sinan, and on the east by Dejen. It is 270 km far from Northwestern part of Addis Ababa town, 289 km away from Southern part of Bahirdar the capital city of Amhara regional state and 42 km far from Eastern part of Debre Markos town, which is the administrative city of East Gojjam. The District is divided into 27 rural kebeles and 3 urban kebeles, Lumame as an administrative town. The District has a total population of 148,013, of whom 73,779 are male and 74,234 female with total area of 74, 129 ha; (Awabel District Communication Office, 2018*).*

Figure 2: Map of the Study Area



Source: CSA, 2007; Ethio-GIS 2015

3.1.1. Area Coverage and Land Use Type

Awabel Woreda has a total area of 86,079 ha. From this around 47839 ha is agricultural land, 8440ha is grazing land, 224ha is covered by natural forest,8216ha is covered by manmade forests, 5571.73 ha land for construction ,402 ha is covered by water and 15386.27 ha is the land which did not used for any purpose. The major landform of the Woreda includes 6.25% mountainous, 82% plain, 0.25% wetland, 10% hummocky, 1.5% valleys and 0.25 others (Awabel District Office of Agriculture, 2018). The major crops and vegetables grown in the study area are Teff, Wheat.Barly, Maiz.Carrot, Cabbage, Onion, lentil, abesh and bean are dominating crops in the study area (ADOA, 2019).

3.1.2. Climate and Soil Type of the Study Area

The altitude of Awabel District ranges an average 2290 m above sea level. According to Awabel District Agriculture office report (2018) the agro climatic zone of the area is about 25% (19781 ha) of the Woreda is kola, 60% (47474.4ha) is Woyna Dega and 15 %(11868 ha) Dega agro-climatic Zone. The average annual rainfall amount of the District is 1125mm and the mean annual temperature of the District is around 19-26°c.The mean annual rainfall amount of the Kebele ranges from1800-2000mm and the soil type of the woreda is 30% red soil, 55% black and 15% is brawn soil. Due to this the dominant soil type is red soil (Awabel District agricultural Office, 2018). The altitude of sekute kebele (study site) is 2200 m above sea level (m.a.s.l) and also the dominant agro-ecology of the Kebele is Woyna Dega.

3.1.3. Irrigation and Water Source Potential of Study Area

Based on the Awabel district water resource office report (2018) the main water resources of the district are perennial streams, wells, rivers, water harvesting ponds and ground water. In the District, there are 7 micro dams with irrigation potential of 135ha, 6 river diversion with irrigation potential of 6300ha from this 2317 ha of land was irrigated with 8622 beneficiaries ,6 communal wells with irrigation potential of 830 ha from this 681 ha was irrigated traditionally with 1932 beneficiaries and 12 private open irrigation wells. According to Sekute enegatera kebele bureau of agriculture report (2018) the total household of the study area (Sekute village) was 1133 from 378 household beneficiaries of irrigation

within 123 ha of irrigated land. The study kebele have two main river catchments used for irrigation purpose, namely Tigade and Bogena river catchment. This study was also conducted in Bogena river catchments.

Figure 3: Bogena river catchment in the study area

3.2. Target Population of the Study

This study was conducted on one of irrigation potential kebele (i.e. Sekute Enegatra kebele) from 27 rural kebeles of the woreda. The target population for this study were irrigation users and non-users in the selected kebele from the total population of the District, the total household of the study area (Sekute Enegatra kebele) was 1133 from this 1029 was male headed and 104 was female headed household. From the total households 325 households are beneficiaries of irrigation within the total irrigation land of 737 ha, the respondents use only 123ha irrigable land whereas 808 of them are non-users, with regard to this the determinant factors affecting small scale irrigation use and its implication on poverty reduction was conducted by taking sample from those users and non-users respondents in the selected kebele.

3.3. Research Design

The study design incorporates mixed research design (quantitative as well as qualitative). Mixed research design refers to the process whereby both qualitative and quantitative elements are interlinked to produce a fuller account of addressing research problem (Zhang and Creswell, 2013). It focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches, in combination, provides a better understanding of research problems than either approach alone."

In this study cross-sectional and observational study were also used. These design were used when the purpose of the study is descriptive often in the form of survey and direct observation and also the study being conducted at a point in time at a single geographical location or for a group of people.

3.4. Data Type and Source

This study used both qualitative and quantitative data type by using primary and secondary data sources. The primary source for this study was collected through direct observation of the study area and reconnesense survey whereas, secondary data source for this study was collected from written documents, published researches, books and other related sources.

3.5. Sampling Size Determination and Sampling Technique

3.5.1. Sample Size Determination

Rao and Richard (2006) suggest that an appropriate sample size depends on the type of problem investigated, required precision and to a certain extent the availability of resources. As the number of factors increase, the sample size should also increase to avoid biasedness of the results.

The sample size (n) can be determined by using the following formula (Cochran, W. G. (1977)).

$n = \frac{no}{\left(1+\left(\frac{no-1}{\mathrm{N}}\right)\right)} = \frac{no}{\left(1+\left(\frac{no}{\mathrm{N}}\right)\right)}$, which is expressed in simplified form.

$$n = \frac{no}{\left(1+\left(\frac{no}{\mathrm{N}}\right)\right)} \qquad \text{where, N}$$

$$= \text{Total number of both irrigation users and non} - \text{users}$$

$$no = \frac{(\mathrm{Z}\alpha/2)^2(\mathrm{pq})}{d^2}$$

$$no = \frac{(1.96)^2 \mathrm{X} 0.5 \mathrm{X} 0.5}{0.07^2}$$

$Z =$ Z- Score associated with appropriately chosen level of confidence (95%) with the table value of (($z_{a/2)}^2$= 1.96) (Cochran, W. G. (1977)).

p=the proportion of farmers who use SSI (it take as 0.5).

q=the proportion of farmers who does not use SSI (it take as 1-p=0.5), and assume d=7%=0.07=degree of accuracy, with 93% level confidence. n =required sample size. Where Zα/2

=1.96 at α=0.05 level of significant, N (total number of household) = 1133

Then using the formula:

$\mathrm{n} = \frac{no}{\left(1+\left(\frac{no}{\mathrm{N}}\right)\right)} = \frac{196}{\left(1+\left(\frac{196}{1133}\right)\right)} = 168$

The total sample size obtained by the above formula can be divided in to equal part in order to reduce the biasedness of the result and to make it proportional sample size between irrigation users and non-users, with in the Table below.

Table 2 : Sample size of the study area.

	User	Non-user	Total
Total household head	325	808	1133
Sample size	84	84	168

3.5.2. Sampling Technique

The study was adopted a multi stage sampling technique of purposively selecting one the District from East Gojjam based on irrigation potential, which is Awabel District. Following this three-stage stratified sampling procedure was used. The first stage involved consultation with Awabel District Agricultural and Rural Development offices, and select irrigation potential area then Sekute enegatera kebele was selected. In the second stage, the household number and lists of the respondents who live in the study kebele were obtained from kebele administration and development agent's office. In the final stage, households were listed by each strata (irrigation users and non-users) then the simple random sampling technique was used to select sample households from each strata using a random number Table from both irrigation users and non-user.

3.6. Data Collection Tools

In this study the primary and secondary data collection tools were used. Secondary data was collected through published documents, personal profiles (for small scale holder farmers), and directives (regarding irrigation techniques), policies and regulations (regarding irrigation agriculture), books and journals (used as literatures) and performance reports (quarterly and annual reports) obtained from Woreda Irrigation Development Office. Primary data was collect through various data collection instruments such as household Survey, Focus Group Discussion and Key Informants.

3.6.1. Household survey

To generate quantitative and qualitative information at household level, household survey was undertaken by using structured and semi-structured questionnaire. The household survey covered personal data, household resources, production, food consumption and income, issues related to determinants of irrigation practice, and its implication on household poverty.

The questionnaire was first prepared in English and later translated into the local language (Amharic language), so that the respondents can easily understand the questions and easily forward their opinion based on those prepared questions. Three enumerators, form the selected kebele was employed based on their ability of local language, culture, and experiences in data collection. Training was provided to the enumerators on the procedure they follow while conducting interview with both user and non-user respondents and discussion was also held to make the questionnaire clear.

3.6.2. Focus Group Discussions

The focus group discussions (FGD) members composed of both men and women. They also involved in individual interview. According to Rule of tamp, in order to conduct an effective interview it should better to use 3 up to 5 FGD. Due to this, the FGD in the study was conducted in to 3 groups 1 FGD form irrigation users and 2 group from irrigation non-user containing 7 individual for each focused group discussion. The output of the discussion was used as a guide to understand main determining factors on small scale irrigation use and to get additional supporting qualitative evidence of the on current situation of benefits gained from irrigation as well as challenges that irrigation user farmers have been faced during the implementation of irrigation activity.

Figure 4: Focused Group Discussion for both irrigation user and non-user respondents

3.6.3. Key Informant Interview

The primary data collected from sample farmers need to be further enriched by additional information gathered through key informants. During this study four respondents were involved in key informant interview. Thus, one from woreda agriculture office, two experts from selected kebele Agriculture office (such as one from kebele irrigation expert and, one from natural resource expert) and also one committee member of irrigation water user's association from study kebele were used for a key informant interview.

3.7. Study Variables

There are two variables in this study:

3.7.1. Response Variable

Small scale irrigation was used as dependent variable.

3.7.2. Explanatory Variables

The determining factors such as Demographic, socio economic, institutional and environmental factors were used as independent variables. Some selected independent variables listed in Table 3 was listed below.

Age of Household Head (AHH): The use of irrigation decrease as the age of the farmer increase Moreover, farmers found in upper age category does not use irrigation whereas young farmers use irrigation (Gebrehiwot *et al.,* 2015). According to Tizita (2017) and other related studies stated that young head of households were stronger and expected to cultivate larger farm size than old heads. Hence, the expected effect of age on household food security could be positive or negative.

Sex of Household Head (SOHH): The sex of the household is a contradictory issue in irrigation use. For instance a studies by Hamda (2014) and Gebrehiwot *et al* (2015) showed that male headed households use irrigation more than that of female headed households. The expected effect of sex on irrigation water use could be positive or negative. But the result was not statistically significant.

Household Family Labor (HHFL): This is a continuous variable and also have direct relation with irrigation use and poverty reduction because from higher family size higher labor force exists, a greater opportunity to use irrigation practice. Gebremeskel (2012) indicated that household size is also found to be statistically significant and positively associated with irrigation utilization. In other words, households with large number of members are relatively high labor force than household with few members. Irrigating households have owned better labor input than non-irrigating households. This is due to irrigation agriculture need more labor as a result farmers earn high income from vegetable production and in turn able to hire more labor than non-irrigators. Similar to other studies, the finding of this study in family labor was positively and significantly related with irrigation water use at 5% significance level.

Educational Status (ES): According to Asayehegn (2011) 2.9% of irrigation users were educated whereas 2.6% of non-users were not educated. The expectation for this study Education is positive and or negative sign. Education is principal influence on income improvement and poverty alleviation. Under this study 42.9% of irrigation user respondents

were above educated. Whereas 46% of irrigation non-user respondent were not educated. It is likely that educated farmers would more readily adopt irrigation technologies and may be easier to train through extension support. The result from this study shows that even the education level of user households were higher than that of non-user respondent, logit model result shows that education of household respondent was not statistically significant factor on irrigation water use.

Access to Credit (ACC): Access to credit is an important source of investment. According to Gebremeskel (2012) credit helps farmers purchase inputs such as seeds, fertilizers and irrigation instrument. Household who get full access to credit was more irrigation beneficiaries than those who does't get access to credit. This study shows that credit access was positively and significantly affect irrigation water use at less than 5% significance level.

Contact with development agents (CDA): It is expected that contact with development agents widens the household's knowledge with regard to the use of improved variety and agricultural positive relation on poverty reduction. This variable entered the model as a dummy variable (takes a value of 1 if the household has access to extension service otherwise 0). Contact with DA was not statistically significant factor for irrigation water use.

Access to Market (ACM): The probability of participation in irrigation for a household was high in access to market than households who do not have access to market. It is dummy variable take the value one who get market access otherwise zero. In this respondents who have market access in the nearest and profitable way produce more valuable and favorite crops and vegetables by using small scale irrigation than who did not access to market and market information and also statistically significance at less than 5% significance level.

Access to Training (AT): It is dummy variable (takes a value of 1 if the household has access to training and otherwise 0).Household who get access to training was better adopter of irrigation practice rather than those who doesn't get training and also positively affect irrigation water use.

Land Holding Size (LHS): land holding size have an important role to use irrigation agriculture. It has a direct relation with irrigation use. A larger size of cultivated land implies

more production and availability of food grains. The size of cultivated land was expected to have positive or negative effect on the use of irrigation practice. In this it was positively and significantly affect irrigation water use.

Dependency ratio (DEPRATIO): Household members aged below 15 and above 65 are considered as dependent and dividing it by household members whose age is between 15 - 64 resulted in dependency ratio (Tizita, 2017). These groups were economically inactive and became burden to other member of household to full fill their immediate food demands. Hence, it is expected that dependency ratio have a negative influence to participate on irrigation activity. It was negatively sign and also the result is significantly affect irrigation water use.

Distance from Water Source (DWS): This is continuous variable negative sign was expected and also the result obtained from the model is also negative sign. Belay and Beyene (2013) identified a strong positive relationship between access to irrigation and household income as well as poverty reduction. Those who have near access to irrigation are more beneficiary than those who live far apart from water source.

Terrain of Farming Land (TFL): This is continuous variable, negative sign was expected and also the result obtained from the model was also negative. The terrain of cultivated land was expected to have positive or negative effect on the use of irrigation practice.

Oxen ownership (OXOWNER): It is direct relationship with irrigation use, positively and significantly affect irrigation water use.

Table 3: Definition of explanatory variables

Explanatory Variable	**Type**	**Measurement**	**Expected sign**
Demographic factors			
Age of the respondent	Continuous	Year	±
Sex of the respondent	Dummy	1 for Male and 0 for Female	±
Household Family size	Continuous	Number	+
Educational Status	Dummy	1 for literate 0 for illiterate	±
Dependency ratio	Continuous	Number	-
Socioeconomic factors			
Land holding size	Continuous	Number	+
Ox ownership	Continuous	Number	+
Institutional factors			
Access to credit	Dummy	1for access to credit, otherwise 0	+
Access to training	Dummy	1 for access to training, otherwise 0	+
Contact with development Agent	Dummy	1 for contact with DA,otherwise 0	+
Access to market	Dummy	1 for access to market, otherwise 0	+
Environmental factors			
Distance from water river	Dummy	Km	−
The terrain of farming land	Dummy	1 for suitable land terrain, 0 for unsuitable	−

3.8. Techniques of Data Analysis

Quantitative data obtained from structured questionnaire was entered into computer for analysis using SPSS software and after completion of data entry, recorded data was exported to SPSS version 20 and make recode. Accordingly, the data was edited, coded, and cleaned. Some consistency checks was verified by running frequencies. The analysis part was done by using both descriptive statistics and econometric model based on the objective of the study.

3.8.1. Empirical Analyses of Determinant Factors on Irrigation Scheme Usage

The determinant factors in small scale irrigation was analysed through Econometric model. According to Gujarati (2004) when the dependent variable is dichotomous which means that it takes 0 or 1 value there is a need of using either logit or probit regression model. Binary logistic regression is typically used when the dependent variable is dichotomous (only two categories) and the independent variables are either continuous or categorical.

The reason behind why the study prefer the logit model than probit model is that because of its simplicity (the equations of logit model are very simple) and its interpretability, while the probit does not have a direct interpretation (Pindyck and Rubinfeld, 1981). By taking this into account this study used the binary logistic regression model to predict the effects of independent variable on dummy (changeable) types of dependent variables. Therefore the determining factors of small scale irrigation was analyzed through binary logit model. The model uses maximum likelihood estimation approach after transforming the response variable in to logit.

Model specification

$$\ln\left(\frac{p_i}{1-p_i}\right) = x_i'\beta \text{----------(1)}$$

$$p_i = \frac{e^{xi\beta}}{1+e^{xi\beta}} \text{ ---------- (2)}$$

Where (Pi) is the probability of practicing SSI, (Xi) donate a set of explanatory variable of household who use SSI, (1−Pi) who do not practices SSI practices and(i) is an individual household observation, e the base of natural logarithm and β is the vector of unknown variable to be explained from the model.

According to Pindyck (1981) and Garson (2008) the final estimated model expressed as follows:

$P_i = \frac{1}{1+e^{xi\beta}}$ ---------- (3)

In the question below Y is a dichotomous dependent variable whether each sample household will be SSI user or non-user: a value 1 indicate household of SSI user,0 indicates non-user and Ɛi is error term.

Y_i=log (odd (event)) $= \log(\frac{pro(event)}{pro(non\ event)})$---------- (4)

$Y_i = \beta_0 + \sum_{n=1}^{\infty}(X_i'\beta) + Ɛ_i$, ---------- (5)

Thus,SSI practice= α + β1age of respondent + β2 sex of respondent + β3 Family labor + β4 educational status of respondent + β5 landholding size + β6 Dependency ratio + β7 Oxen ownership +β8 market access +β9 access to credit + β10 access to extension service + β11 access to training + β12 distance from water source + β13 Terrain of farming land + ε

Where, Small scale irrigation = $\begin{cases} 1 \text{ if SSI irrigation user households} \\ 0 \text{ if SSI irrigation non-user households} \end{cases}$

α = is an intercept

βi = coefficients for the independent variables

ε= error term changing variable

X=independent variables that determine the factors affecting on the use of SSI.

3.8.2. Empirical Analyses of the Implication of SSI on Poverty Reduction

This study used descriptive statistics to analyze the implications of practicing small scale irrigation for poverty reduction by explaining independent variables, and also poverty indices are used to determine the poverty status and severity of poverty among irrigation user and non-user households. Furthermore, data collected through key informant interviews and focus group discussions was analyzed using textual and tabular analysis. Frequency distribution and percentages was used to describe major variables.

3.8.3. Empirical Analysis on Challenges Faced in Small Scale Irrigation Use

The challenges faced on user respondents during irrigation water use was analyzed by descriptive statistics by using frequency distribution and percentage through textual and tabular basis based on the data obtained from key informant interview as well as focused group discussion of irrigation user respondents in the study area.

CHAPTER FOUR

Result and Discussion

4.1. Description of sample household characteristics

In this section, the sample households Demographic, Socio-economic, Institutional and Environmental factors related to small scale irrigation use were discussed by using descriptive statistics such as mean, percentage, mean difference and standard deviation and inferential statistics such as Chi-square test and T-test to understand the characteristics of study households.

4.1.1. Demographic and Socioeconomic Characteristics of Sample Household

4.1.1.1. Sex of the Respondent

In the study area sex have its own contribution on the use of irrigation water. The results presented in Table 4 shows that out of the total irrigation user respondent's 76.2% were males and 23.8% were females. Whereas, from the total non-user respondents, about 64.3% were males and 35.7% were females. The result shows that the proportion of males in the case of irrigation user respondents was more than that of non-irrigation user respondents. Male-headed households were in a better position to use irrigation than the female headed ones. Moreover, with regard to farming experience, other agricultural and irrigation activity males are better than that of female farmers. Therefore, male headed households were highly irrigation beneficiaries than female headed households.

4.1.1.2. Age of the Respondent

The survey results in Table 4 indicate that 47.6% of total sample respondents was aged ranges from 41-60 years old. But out of the total respondent 57.1% of user respondents were aged ranges from 41-60 years old while, 48.8% of non-user was aged from 61-80 years old. The mean age of total respondents was 42.13 years. However, the mean age of irrigation user respondents' was 40.2 years old and non-user respondents' was 44.05 years. The result shows that younger household heads being involved in irrigation activities than the older

household heads. Other finding such as petros (2017) and Getaneh (2011) indicated that age has both positive and negative relationships with access to irrigation water due to its nonlinearity. So, as the age increases, the demand for irrigation use would be expected to decrease because of inability to do irrigation activity, due to old age. It also affects households' income negatively and also an indicator of poverty.

4.1.1.3. Education of Household Head

Economic growth is driven by change in people's capabilities or their human capital, as affected particularly by their education. Educated people can more easily contribute to the generation of new technologies and more readily utilize those technologies. It is one of the main factors affecting use of small scale irrigation to improve agricultural productivity (petros, 2017). In Table 4 below, 40.5% of user respondents were illiterate, 59.6% were above read and write, whereas 54.8% of non-users were illiterate. The survey result shows that a higher percentage of irrigation non-users were illiterate. Whereas higher percentage of irrigation users were educated. Therefore, education was one of the important criteria to accept and apply irrigation activity.

4.1.1.4. Land Holding Size of the Respondent

Land is the major productive asset in agrarian countries like Ethiopia. Cultivated land appears to be the most important scarce factor of production. In the study area, own land, rented and shared lands was used for cultivation, but the survey focused on own land of both user and non-user households.

The result presented in Table 4 shows about 39.4% and 44% of irrigation user households have less than 1 ha and 1-1.5 ha respectively, whereas 63.1% and 32.1% of non-irrigator households have less than 1 ha and 1-1.5 respectively. Thus, the overall land holding per household among the study group is varied. According to the survey result, irrigation user households have a larger cultivated land area than non-user households. Irrigation may generate income and allow accumulation of other productive assets for irrigating households, which facilitate cultivation of additional land through share in and rent in from non-irrigating households (Abebaw, 2015).

4.1.1.5. Oxen Ownership of the Respondent

Like in most parts of Ethiopia, oxen are the engines for agricultural works in the study area. There is a positive relationship between crop production through small scale irrigation activity and oxen ownership of household headed respondent. According to Petros (2017), Oxen provide manure and used to boost crop production as well as a major contributor for irrigation water use. The survey result in Table 4 shows that the total respondents who have no oxen were 24.4%, whereas 44.6% of total respondents have 1-2 oxen. Out of the total respondent 39.3% and 34.5% of irrigation non-user households have 1-2 oxen and no oxen respectively, while 50% and 35.7% of irrigation user respondents have 1-2 and 3-5 oxen respectively, but a small percentage of user respondents have no oxen. Therefore, respondents who have large number of oxen have better opportunity to use irrigation and ploughing more land on time than that of respondents who have no oxen.

Table 4: Demographic and socio economic characteristics of sample respondent

Variables	User		Non-user		Total	
	N	**%**	**N**	**%**	**N**	**%**
Sex of respondent						
Male	20	23.8	30	35.7	50	29.8
Female	64	76.2	54	64.3	118	70.2
Age of respondent						
20-40	21	25	11	13.1	32	19
41-60	48	57.1	32	38.1	80	47.6
61-80	15	17.9	41	48.8	56	33.3
Mean	40.2		44.05		42.13	
Std.Devation	11.09		11.9		11.68	
Education level						
Illiterate	34	40.5	46	54.8	80	47.6
Read and write	36	42.9	33	39.3	69	41.1
Junior complete	10	11.9	2	2.4	12	7.1
High school and above	4	4.8	3	3.6	7	4.2

Variables	User		Non-user		Total	
	N	**%**	**N**	**%**	**N**	**%**
Land holding size						
Less than one hectare	33	39.4	53	63.1	86	
1-1.5 hectare	37	44	27	32.1	64	
1.5-2 hectare	6	7.1	1	1.2	6	
Greater than 2 hectare	8	9.5	3	3.6	11	
Oxen ownership						
No ox	12	14.3	29	34.5	41	24.4
1-2	42	50	33	39.3	75	44.6
3-5	30	35.7	22	26.2	52	31
Mean	1.21		0.92		1.07	
Sta.Devation	0.68		0.78		0.74	

Source: Field survey, 2019

4.1.1.6. Family Labor of the Respondents

In rural Ethiopia, household family is the main source of labor for all income sources. Family size in adult equivalents indicates the sample households‟ average family labor force of production and other income-generating activities (Adugna, 2013). According to CSA (2007), the average family size at the national level in Ethiopia was 4.7.Table 5 shows that the average family labor in adult equivalents in the study area was 3.18, the average labor force for irrigators was 3.63 and 2.73 for non-irrigators, which shows that user communities were use more labor force than that of non-users because irrigation need more labor force starts from land preparation up to harvesting time. Therefore, labor force is one of the important entity to use small scale irrigation in the study area.

4.1.1.7. Dependency Ratio of the Respondent

The dependency ratio shows the ratio of economically inactive compared to economically active. Economically active members of a household, whose age is from 15 to 64, are assumed to be the principal sources of income for the household. Household members under 15 and over 65 are assumed to be economically inactive and dependent on economically active members of a household for education, clothing and health care (Tizita 2017). The dependency ratio of agricultural households provides planners and policy makers with an

indication of agricultural labor availability in male- and female-managed holdings and their abilities to actively participate in agricultural programs and projects. The survey result shows that the mean of non-user households was higher in the dependency ratio than that of user respondents. Members of households with high dependency ratios might not be able to participate in irrigation agriculture due to time, labor and/or financial constraints, that is, the dependency ratio is thought to be negatively related to income of households (FAO, 2016). In the study area, the average dependency ratio was 138 %, which means every 100 economically active persons had 138 extra persons to feed, cloth, educate and medicate. Economically active members were less than non-active household members.

Table 5: Descriptive results of continuous variable

Characteristics	User =84		Non-use =84		Total =168	
	Mean	SD	Mean	SD	Mean	SD
Family Labor	3.63	1.37	2.73	0.93	3.18	1.24
Dependency ratio	1.25	1.01	1.51	1.11	1.38	1.07

Source: Field survey, 2019

4.1.2. Institutional Characteristics of Sample Household

4.1.2.1. Access to Credit

The survey results in Table 6 show that in 2018/19 out of the total respondents, about 60.1% of the respondent got access credit. However, out of the total respondents, about 81% were irrigation user respondents and 38.3% were non-user respondents. Whereas 39.9% of total respondents did not get access to credit, from this 19% was user respondent but 60.7% was irrigation non-user respondents. This result shows that the variation in the credit access between two groups has its own implications on the use of irrigation water.

4.1.2.2. Contact with Development Agent

Development agents provide crucial farming information in the study area, especially in the application of irrigation water for farming activities. The results in Table 6 show that 39.3% of total respondent's contact with DA four times per month. Thus, from the total respondents,

59.5% and 19% of irrigation user and non-user respondents were contact with DA more than four times per month respectively. However, 21.4% of total respondent's contact with DA less than two times, from this 8.3% and 34.5% irrigation users and non-users respectively contact with DA less than two times. Therefore, farmers who had better contact with DAs have better chance to use irrigation.

4.1.2.3. Access to Training

The survey results obtained from the respondents' household in the Table 6 below show that 60.1% of total respondents was attended training on irrigation related practice. Whereas, 39.9% of the respondents did not get access to training. However, out of the total irrigation user respondents more than half (83.3%) attended training on irrigation related practice while from total respondents' household, about 63.1% did not attend training on irrigation related practice. This shows that the variation in participation of training between two groups has its own implications on the use of irrigation water. The study kebele KI explained that most of irrigation users were those respondents who participate in any training activity in kebele as well as woreda level and also have adequate knowledge about how to implement and why to implement irrigation activity than those irrigation non-users. Therefore, better attended farmers have better chance to use irrigation.

4.1.2.4. Market Access

Market access is important to improve the income of the respondents through producing more market valuable product. The survey results obtained from sample respondents' shown in Table 6 explained that 69% of total respondents' got access to market while from total sample households 31% of them did not get access to market. Though, out of the total respondent more than half (78.6%) of user respondent and 59.5% of non-user were get available market access to sell their product. According to key informant interview, most of the respondents were travel long distance to sell their product and also there was no enough transport to get market access easily. Therefore, respondents who get access to market and market information was a greater opportunity to use irrigation.

Table 6: Institutional Characteristics of the respondent household

Access to credit	**User**		**Non-user**		**Total**	
	N	%	N	%	N	%
No	16	19	51	60.7	67	39.9
Yes	68	81	33	38.3	101	60.1
Contact with DA per month						
>4	50	59.5	16	19	66	39.3
2-4	27	32.2	39	46.4	66	39.3
<2	7	8.3	29	34.5	36	21.4
Access to training						
No	14	16.7	53	63.1	67	39.9
Yes	70	83.3	31	36.9	101	60.1
Market access						
No	18	21.4	34	40.5	52	31
Yes	66	78.6	50	59.5	116	69

Source: Field survey, 2019

4.1.3. Environmental Characteristics of Sample Household

4.1.3.1. Household Farm Distance from Rivers

The survey result in Table 7 shows that 32.1% and 27.4% of total respondent household is located farm distance >1.5Km and 0.5-1 Km respectively away from the river. However, out of the total sample respondents, about 46.4% of irrigation users found in farm distance of 0.5-1Km away from rivers. While 64.3% of non-user and none of user respondents found in farm distance of >1.5 Km away from rivers. The Chi-square value shows that there is an association between farm distance from river and irrigation water use at 1% significance level. This shows that the variation in distance from river between two groups has its own implications on the use of irrigation water. Therefore, farmers' whose farm was located near to the river have better chance to use irrigation. Hence, they can more likely produce

two to three times a year. For instance, users have location advantage to exploit higher volume of irrigation water than the tail-end groups.

4.1.3.2. Terrain of Farming Land

The survey result in Table 7 shows that out of the total sample respondent about 41.7% of user and 64.2% non-user respondents have farming land which was not suitable for irrigation purpose. While from the total respondents which have suitable land 58.3% were irrigation user and 35.7% of them were non-users. This indicates those respondents who have suitable land area were better opportunity to use irrigation than that of unsuitable land area. According to focused group discussion unsuitable land area need more cost, labor and skill to make it functional for irrigation activity. The Chi-square value shows that there is a strong relationship between the terrain of farming land and irrigation water use at 1% significance level.

Table 7: Environmental Characteristics of household respondents

Distance from	**User**		**Non-user**		**Total**		**Chi-square value**
water source	N	%	N	%	N	%	
< 0.5	29	34.5	2	2.4	31	18.5	
0.5-1	39	46.4	7	8.3	46	27.4	
1-1.5	16	19	21	25.2	37	22	
>1.5			54	64.3	54	32.1	101.221***
Terrain of farming land							
Unsuitable	35	41.7	54	64.3	89	53	8.626***
Suitable	49	58.3	30	35.7	79	47	

Source: Field survey, 2019.P-value of 0.000 and 0.003 respectively significance at 1%

4.2. Poverty Status of Sample Household

The national level food and total poverty line set by the Ethiopian government are ETB 1985 and 3781 respectively (MOFED, 2012).for this study, absolute food poverty line of ETB 3781 expenditure for each adult per annum, Sample households whose expenditure for every adult per annum is greater than and equal to ETB 3781 are considered to be non-poor, otherwise poor.

As shows in the Table 8, from 168 sample households, 24.4% of them are below poverty line(below ETB 3781 adult equivalent), which accounts for 39.3% of non-users and 9.5% of them was users, The rest 90.5% irrigation users and 60.7% of non-users were above poverty line. This implies that irrigation development is a key for poverty reduction. The fact that 9.5% 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.

According to Anware (2014) and Adugna (2013), there was a positive and direct relationship between poverty and irrigation water use. This study also confirms that irrigation user households were less likely to expose by poverty than that of irrigation non-user households.

Having the poverty threshold, estimates of poverty namely head count; poverty gap and squared poverty gap are evaluated in order to assess the present status, depth and severity of poverty in the study area.

Head count index: It is the share of sample households whose basic needs expenditure per adult equivalent is below the poverty line. That is, the share of households that cannot afford to buy the basic basket of items (Girma, 2017). From this, a headcount ratio was used to determine the share of households (n) which are below the poverty line in the population (N).The headcount ratio (H) is given as:

$$H = n/N$$

The study in table 8 shows that 39.3% and 9.5% of the non-user and user households respectively were living below the locally determined poverty line on the head count basis.

In the result of the estimation, it is indicated that the poverty incidence in the study area is 29.8 % at the absolute poverty line, that is, ETB 3781. This proportion implies the percentage of the sampled population who is unable to meet the required minimum amount of calorie for each person per day. In other words, this proportion of households does not fulfill the minimum amount of income (ETB 3781) to satisfy the minimum calorie requirement per adult equivalent/ day.

Poverty gap index: This index provides information on how much poor household's mean aggregate consumption shortfall relative to the poverty line across the sample. It is the difference between per capita expenditures and poverty line and then divided by the poverty line. It is, therefore, a much more powerful measure than the head count ratio because it takes into account the distribution of the poor below the poverty line. That is, it reflects the per capita cost of eliminating, poverty assuming perfect targeting of resources. In this study the corresponding poverty gap by small scale irrigation use was 0.037(3.7%) and 0.14(14%) for user and non-user, respectively; this indicates, poverty was more likely distributed among irrigation users than non-users.

Poverty severity index**:** It is the square of poverty gap and also predict the how much poverty is sever in sample respondents. The poverty severity index for this study was 0.02(2%) for irrigation users and 0.07(7%) for irrigation non-users. The results indicates that irrigation non-users was highly exposed for poverty than that of irrigation non-users. Several literatures such as Girma and Temesgen, (2017) studied that, irrigation development helps to increase household income and reduces the incidence of poverty at the household level.

Thus, according survey data, poverty is more severe and widespread among non-irrigators than irrigators.

Table 8: Poverty status and indices of the respondent household

SSI irrigation use	**Poverty status**				**Chi-square**
	Poor		**Non-poor**		
	N	%	N	%	
User	8	9.5	76	90.5	
Non-user	33	39.3	51	60.7	
Total	41	24.4	127	75.6	123***
SSI irrigation use	**Head count index**	**Poverty gap**	**Poverty severity index**		
User	0.095	0.037	0.02		
Non-user	0.39	0.14	0.07		

Source: Computed from field survey, 2019. P value of 0.005

4.3. Implication of Small Scale Irrigation on Household Poverty Reduction

The study also tried to find out irrigation had some direct contribution to households especially on some poverty indicators and the response is presented in Table 9. The results indicates that irrigation practice has an influence on these indicators as total of 81% representing 89.3% of the respondents had mentioned its benefits in terms of income,83.3% increase agricultural output and reduce indebtedness,72.6% create employment ,stabilization and risk reduction, 84.2% reduce food price, which contributes to the total wellbeing of individuals. Whereas 9.5% of them disagree on the benefit gained from irrigation in terms of stabilization and risk reduction, while 13.1% of the respondent strongly agree that small scale irrigation reduce indebtedness. According to Adugna *et al*., (2013) small scale irrigation played an important role to increasing production, income, assets, and employment opportunity, as well as poverty reduction. On the other hand irrigation user had better annual income and livestock ownership as compared to irrigation non-user households. Having access to irrigation had significantly improved the living standards of farming households.

Table 9: Benefit gained from small scale irrigation

Benefit gained from SSI	Response given from user household							
	Disagree		Uncertain		Agree		Strongly Agree	
	N	%	N	%	N	%	N	%
Increase income	2	2.4	6	7.1	75	89.3	1	1.2
Improve Agricultural output	1	1.2	6	7.1	70	83.3	7	8.3
Employment	5	6	16	19	61	72.6	2	2.4
Reduce indebtedness	1	1.2	2	2.4	70	83.3	11	13.1
Stabilization and Risk reduction	8	9.5	8	9.5	61	72.6	7	8.3
Reduce food price	4	4.8	1	1.2	71	84.2	8	9.5
Total		4.1%		7.8%		81%		7.1%

Source: Field survey, 2019

4.3.1. Small Scale Irrigation Increase Income

It is expected and revealed that irrigation would improve income earning (Getaneh, 2011; Hussain, 2004; Kinfe et al., 2012; Adugna et al., 2013). Similarly, irrigation beneficiaries earned an annual mean income of Birr 33846.8 per household, which is 41.02% higher than that of non-users. Irrigation use has a positive impact on households earning from crop and livestock. Close examination of the data exhibit that remunerative off farm income sources like cart, beverage 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 (Adugna *et al*., 2013). This finding is similar to the findings of Getaneh (2011) and petros (2017) which states small-scale irrigation has a negative impact on non-farm incomes. Irrigation non-users increased by 73.1% in off farm activity, this is due to the fact that user need high labor force than non-users, so there was no labor force to do other off farm and non-farm activity.

Income share by each category indicate that 86.8% and 80.4% of total incomes for users and non-users respectively come from crop, while the rest from livestock and off farm activities. Irrigators earned 52.3% higher than that of non-irrigators from crop alone not only for crop but also increased by livestock and irrigation agriculture and this difference is statistically significant at 1% in crop and total income, even if there is negative mean difference in off activity between users and non-users. The t-value shows that, off farm activity is not statistically significant at less than 5%.

4.3.2. Irrigation Improved Household Consumption

In order to measure the contributions 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 irrigator's was higher than non-irrigators. Similarly, the value of home consumption, food and non-food expenditures of users are significantly higher than that of non-users. The annual expenditure of user respondent was less than their annual income (i.e. Irrigation users consume 96.6% of their income).whereas the annual expenditure of non-users was higher than their annual income. For instance non-irrigators consumption expenditure from own production is only about 75.4% of that of irrigation beneficiaries. Therefore non-users need 24.6% credit from users to fulfill their household needs. Due to this most of irrigation users were non-poor whereas irrigation non-users were poor.

This indicates that access to irrigation improves food security through home consumption by increasing the frequency of production. Thus, there is a positive correlation between consumption expenditure and irrigation access. It has also a positive impact on non-food consumption. The food consumption value of users was 54.6% from total consumption. Thus, this study could argue that irrigation access improves overall welfare of rural households. The annual food expenditure of irrigation users were 17% higher than non-users. Whereas the total expenditures of irrigation users were 24.5% higher than that of non-users. The t-value also shows that there is a significance mean difference between irrigation users

and non-users with respect to food, non-food and total expenditure at less than 5% significance level.

Table 10 **:** Household income and expenditure of the respondent

Income source	**User**	**Non-user**	**t- value**
(ETB)	Mean	Mean	
crops	29396.5	19307.7	6.524***
Livestock	3924.7	3783	2.106**
Off farm	526.2	910.7	-1.402
Total	33846.8	24001	5.172***
Consumption expenditure (ETB)			
Food	17864.3	15179	12.019**
Non-food	14852	11095	27.596***
Total	32716.6	26274	18.817 ***

Source: Field computation with p-value of 0.0370, 0.001 and 0.000 respectively.

4.3.3. Small scale irrigation improve housing type

Types of housing are an indicator of improving the well-being of rural households. In rural Ethiopia most of the houses are grass-roofed, but wealthier households have a corrugated iron roof.

In this study 90.5% and 9.5% of small scale irrigation user household heads were corrugated iron roofed and grass-roofed houses respectively. While, from non-users 71.4 % were corrugated iron roofed and 28.6 were grass-roofed houses. According to the finding of Gebremeskel (2013) and Getaneh (2011) housing type is one of the indicator for poverty status of respondent households and also they explained that most of respondents who have Corrugated iron-roofed were irrigation users but their findings was not statistically significant. Therefore, higher percentage of user households in the sample had corrugated

iron roofed houses than non-user households and also there is positive association between housing type and small scale irrigation usage at 1% level of significance.

Table 11: Housing type of the respondent

Type of house	**User = 84**		**Non-user= 84**		**Chi-square**
	Frequency	Percent	Frequency	Percent	
Grass roofed	8	9.5	24	28.6	8.485***
Corrugated iron roofed	76	90.5	60	71.4	

Source: Field survey, 2019. P-value of 0.004, significant at less 1%

4.4. Determinant of small scale irrigation use

Farmers' decision to use irrigation is determined by various Demographic, Socio economic and Institutional and Environmental factors.

In view of this, efforts were made to include variables found relevant in the model in order to clarify the response of the farmers in the study area. In this section determinants of small scale irrigation was explained, Logit model was fit to estimate the effects of the hypothesized explanatory variables on the probabilities of being irrigation user or not. Before the estimation of the model parameters, it was found important to look into the mean difference of individual variables with regard to irrigation water use. The variables in the model were selected on the basis of theoretical explanations, personal observations and the results of the survey studies. Small scale irrigation use is considered as the dependent variable of the model, while the variables listed in Table 12 are independent variables that determine the likelihood of being irrigation user or not.

Table 12: The binary logistic result of independent variables

Variables	B	S.E	Wald	P –value	Exp(B)
Age	2.050	0.548	14.017	0.000***	7.771
Sex	-0.205	0.617	0.110	0.740	0.815
Education	-1.060	1.258	0.710	0.399	0.346
Family labor force	0.163	0.213	0.582	0.040**	1.176
Land holding Size	2.818	0.973	8.395	0.004***	16.740
Oxen ownership	1.538	0.707	4.735	0.030**	18.587
Market access	1.189	0.565	4.429	0.035**	3.282
Contact with DA	1.153	1.034	1.242	0.265	3.166
Training	1.384	0.503	7.561	0.006***	3.990
Credit access	1.402	0.527	7.067	0.008***	11.421
Dependency ratio	-0.042	0.176	0.056	0.812	0.959
Terrain of FL	-0.824	0.510	0.504	0.100*	0.437
Distance from river	-1.841	0.540	11.613	0.001***	0.159
Constant	-4.286	2.135	4.028	0.045	0.14
Correctly predicted user	86.1				
non-user	85.3				
Over all percentage	85.7				
Chi-square value	121.431				
Sample size	168				

a.Variable(s) entered on step 1: Age, Sex, Education, Family labor, Land holding size, Oxen ownership, Market access, Contact with DA, Training, Credit access, Dependency ratio, Terrain of FL and Distance from rivers. *, **and *** represent significance at less than 5% and 1% level respectively.

Source: Computed from field survey data, 2019.

Age of Respondent

Age of the respondent was a significant and positive effect on irrigation water use at 1% significance level. The odd ratio indicates that the respondents who have an old age were 7.771 times less likely to use irrigation water than young age respondents. Therefore, respondents with younger aged was engaged in irrigation activity than those who have old aged respondent.

Family size engaged in agricultural labor force

Family size engaged in agricultural labor force had significant and positive effect on irrigation water use at 5% significance level. The odd ratio also revealed that as the labor force in the household increases by 1 unit the probability of using irrigation increases by 117.6 times. Due to this the respondents with large family size engaged agricultural labor force have a better chance to use irrigation water. According to Focused Group Dissociation "irrigation is the labor intensive practice and it needs a high labor force for diversion of water from the river and the application of water on the farm". Similar to this study, Agidew (2016), Petros and Yisehak (2017) have reported in their study, irrigation farming is extremely labor intensive.

Land Holding Size: It was found that land holding size had positively and significantly influenced the probability of use irrigation at 1% significance level. This result implies that farmers with large land holding size are more likely to use irrigation than those farmers who have small land holding size. According to FGD, in study area land holding size is a very important resource to use irrigation, because farmers which have large land holding apply irrigation and also they explained that most of the non-irrigators are those who have small land holding size. Therefore, it is one of the main factors of most respondents in the study area. The odds ratio for land holding size indicates that, other things being constant, the odds ratio in favor of using irrigation increases by a factor of 16.740 as the land holding size increases by 0.5 hectares. The study conducted by Petros and Yisehak (2017) and Abebaw *et al* (2015) stated that the availability of appropriate land holding size is highly important when farmers are ready to adopt new technology.

Oxen ownership: It was one of the constraint in small scale irrigation water use**.** The survey result shows that oxen ownership positively and significantly affect irrigation use, the odd ratio result shows that respondent, who have 3-5 oxen were more likely use irrigation by the factor of 18.587. While, respondents who have no ox were less likely to use irrigation and its affect negatively because oxen are the major engine for any agricultural activity on the study area. According to Focused group discussion (FGD), oxen are one of the productive asset and every agricultural activity is done by oxen in the study area. Due to this most of irrigation users were oxen owners to perform irrigation activity.

Market access: This had significant and positive effects on the use of irrigation water at 5% significance level. As the result indicates those farmers who got access to market had more chance to use irrigation water than those who did, t got market access. The odd ratio indicates the respondents who got access to market 328.2 times more likely to use irrigation water than those who did, t access to market. Key informants and Focus group explained that there was no available market access that residents sell their products without any transportation cost and they also explained that half of the kebele residents are nearer to market and mostly they use irrigation, whereas the remaining residents travel long distance to sell and buy different products. Therefore, the existence of limited market access is one of the factors affecting irrigation water use in the study area.

Access to training: This had significant and positive effects on the use of irrigation water at 1% significant level. This implies that all other things being kept constant, the odds ratio in favor of small-scale irrigation use increases by a factor of 3.990 for those respondents who have got access to training and technical advice regarding to irrigation activities. The result indicates those respondents who participated in training had more chance to use irrigation water than non-trained respondents. The result obtained from key informant interview revealed that in the study area the trained farmers easily understood the benefit gained from irrigation as well as operation and adopt improve irrigation technologies that increase their access to use irrigation water through lifting with irrigation technologies (motorized water pump) from the sources even if their farm is not accessible to irrigate through gravity force.

The study conducted by Abebaw (2015) also stated that more training and technical advice is provided by the extension agent to the farmers, the higher probability of the farmers to utilize small scale irrigation.

Credit Access: This had significant and positive effects on the use of irrigation water at 5% significance level. The odd ratio indicates the respondents who get access to credit was 11.421 times more likely to use irrigation water than those who did, t get access to credit. The result obtained from Focused group discussion revealed that, those households who have access to credit have better possibility to use irrigation and spend on activities they want either they purchase agricultural input (improved seed, fertilizer, irrigation equipment's, etc.,) or they purchase livestock for resale after they fattened them and also they explained that access to credit used to bought household materials such as solar light, motorized water pump or generator which is easier to distribute water in their irrigation farm than those respondents who did not get access to credit. Previous research result reported by Petros (2017) and Awulachew *et al* (2010) confirmed that access to credit positively influences the adoption of irrigation agriculture. Therefore, those households who have access to credit became capable of using irrigation than those who have no access to credit. Therefore, those farmers who get access to credit had more chance to use irrigation water than those who did, t get credit access.

Farm distance from the rivers: had a significant and negative effect on non-irrigator households' at 1% significance level. The result indicated that as distance to the water source increases by 0.5Km the probability of using irrigation water decrease by 15.9 percent. The model result indicated that those households whose farm is located far from the rivers had less chance to use irrigation water and vice versa. Because, in the study area the major water source for irrigation is rivers. When the farm land is far from main irrigation canals, it needs high labor, financial and time costs to construct sub canals towards the individual farm as well as to irrigate their fields and minimize the chances to use irrigation water. A Similar study conducted by Abonesh (2006),Petros and Yisehak (2017) states that most household heads that live near the irrigation scheme have more a better chance to use irrigation water than those household heads who are far from irrigation water. Kebele key informants

explained that households near the irrigation scheme do not acquire additional costs of transportation and traveling time and also have a better opportunity to participate in irrigation activity.

Terrain of farming land: The binary result shows the sloppiness of the farming land had Significant and negative effect on non-irrigator households' at 10% significance level. The result indicated that those respondents who have flat agricultural land area had easy to use irrigation because their land is suitable for irrigation without expenditure. Whereas, respondents who have unsuitable land area were non-users.

4.5. Challenges faced in small-scale irrigation use

Small-scale irrigation has immense potential to improve the incomes of poor rural households in developing countries like Ethiopia. However, the performance and effectiveness of both traditional and formal small-scale irrigation schemes are constrained by multidimensional problems ranging from individual farmers' attitude to institutional arrangements. A field survey with field observation, focus group discussion and key informant interviews indicate that small-scale irrigation's benefits are accompanied with multidimensional problems. The problems of small-scale irrigation use start from individual household's subjective attitudes to institutional arrangements. The major problems encountered in small-scale irrigation in the study area are problems related to cost, institutional problems, the policy environment, design issues, cultural factors and environmental problems. The major challenges for small scale irrigation in study are ranked below based on their severity.

4.5.1. Crop diseases

According to field observation crop disease was one of the major challenge in the study area. This disease attack the most productive part of crops and vegetables, especially onion and maize. Based on the explanation of focus group discussion of user respondent, the study area is intensively cultivated with the same crops such as onion and tomato are repeatedly grown for long periods of time. This type of production system reduces the productivity of their irrigated land. In addition to the loss of productivity and fertility, this cultivation strategy

facilitates crop disease like root rot and cut worm. Imported inputs to control these problems, such as herbicides and pesticides are costly for farmers to purchase and also some herbicides are ineffective. Due to this reason most of the respondents produce similar crops that was not easily attacked by diseases. Thus diseases and pests are limiting factors for the economic benefits of small-scale irrigation activities in the study area.

Figure 5: Field observation of worm eaten onions

4.5.2. Inadequate awareness and experience of farmers' in irrigated agriculture

Even if there was a vast experience on using irrigation in the study area, still there is no awareness on effective utilization of irrigation water based on crop water requirement. Therefore, a lack of educated experience and skill is ranked as second problem next to crop diseases problem. Based on the focused group discussion there was no enough supportive structure in agricultural extension on training for irrigated agriculture from kebele agriculture office as well as other concerned body. Irrigation is just seen as additional and

other seasonal packages of program. Most of the farmers harvest twice a year, but their harvest is lower than their rain fed harvest.

4.2.3. Lack of necessary inputs

It is interrelated with the farmers' awareness and supply. Inputs such as vegetable seeds, fruit seedlings, crop pesticides and improved seed fertilizers are not accessible. In case of commercial fertilizer the price is not affordable. Based on the focused group discussion vegetables such as onion, cabbage and potatoes were not grown in recent due to pest, so in the district, there was no pesticides to remove those pest that damage the most productive part of vegetables. Due to the respondents grow less productive vegetables such as potato that is not easily attacked by pests.In addition, there is no irrigation supportive that can facilitate input and market supply in the study area.

4.2.4. Problem of water distribution

Based on the group discussion and key informant interview irregular water distribution was the main problem that causes water logging at the upper and shortage of water at the downstream of the command areas. On the other hand, there has been no standardized watering interval schedule to each crop. Water is distributed based on the type and need of vegetables and crops, not on their banal order. They irrigate potato once within a week and also when the diseases occur, they irrigate their land consecutively in order to remove vegetable disease traditionally. Thus, poor distribution system and inefficient use of water resource is the common feature of the small-scale irrigation scheme in the study area.

Figure 6: Water loss during the field was irrigated

4.2.5. Lack of water user committee

The water user committee is the main responsible body for managing any irrigation scheme including operation and maintenance, fee collection, fair distribution and other activities that increase the efficiency of irrigation water. However the survey revealed that, there is no committee formulated to do that in study scheme. Hence repairing of the canal and protecting against any misuse activities that might damage the canal and over the entire irrigation scheme is less practiced. The beneficiaries of the irrigation mend the canal when there is any canal damage at the end of the rainy season only as community mobilization.

4.2.6. Lack of coordination

Based on the key informants' response less integration between Agriculture office and water resource office is the source of mismanagement and water loss in the irrigation scheme. Instead of doing the activity coordinately, their subordinate construction structures and

establishment of water user committee is the responsibility water resource office and the agronomic practice is duties of Agricultural office. However Water resource office emphasizes on physical works mainly in design and construction but not in irrigation management, which require a detailed understanding of agricultural process and the farming community. Therefore, this divided pattern of organization had an unsatisfactory result on the overall achievements of the irrigation development in the study area.

4.2.7. Problem of water scarcity

According to the desiccation in key informant interview and focused group desiccation water shortage in dry season is one of the problem in irrigation users due to the shortage of advance irrigation technology that enable to save water. According to field observation almost all of irrigation user respondents use traditional irrigation technology (i.e. Furrow irrigation system) to irrigate their farm land. This type of traditional irrigation system is one of the cause for water scarcity in the study area.

Figure 8: Traditional Furrow irrigation system

4.2.8. Lack of Storage facilities

According to FGD of user respondent described that lack of storage facility and absence of proper functioning farmers' cooperative's causes farmers bargaining power especially on the marketing of cash crops is low. Most of the respondents grow similar and less market centered products potato, maize and Onion, the dominant cash crops, often harvested by farmers at the same time, which leads to a high availability and low prices during the main marketing period. Due to this reason products quality deteriorates rapidly, because there is

no efficient storage system in the study area, which means that farmers must sell within a very short time, often they consider this to result for low prices.

CHAPTER FIVE

Conclusion and Recommendation

The objective of this study was to assess determinants of small scale irrigation and its contribution to poverty reduction at the household level. The study was conducted in Awabel district, in East Gojjam Zone.

5.1. Conclusion

Access to irrigation increases the opportunity for crop intensity and diversification, which increase cropping income and reduce poverty. Even if irrigation practice has various benefits, there are various factors that influence on the use of irrigation. This study identifies key factors that influence use of irrigation in the study area. This insight is also useful to rethink about the barriers of use of irrigation.

In the study area one of the main constraints for irrigation nonuser respondent households is living far distance from rivers. These factors was negatively and significantly affected the use of irrigation water at 5% significance level.

The Committees have high responsibility to manage irrigation water used from rivers. However, these committees were assigned symbolically have not well function their responsibilities. Therefore, it was negatively affecting the fair distribution of irrigation water for the users in sample Kebeles. The other constraints on irrigation water use were an age of household head, land holding size, access to market, family labor, training and credit were positively and significantly affect at 1 % and 5% respectively. Which means households who get access those listed factors were irrigation users, otherwise non-users.

This study also assesses the implications of irrigation on poverty reduction the household level. The study result shows that SSI was its own implication on increasing production, income, reduce indebtedness, and improve living standard, as well as poverty reduction

Thus, it is relevant 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.

5.2. Recommendation

Small-scale irrigation is an important development effort to ensure farm income and reduce poverty if properly implemented. Based on the empirical findings reported in this thesis, the following recommendations are progressed.

- Distance from rivers had a significant and negative effect on the use of irrigation water and the main sources of irrigation water in the study area are rivers. It is recommended that the concerned bodies such as government, NGO and other stakeholders should emphasis on construction of new main irrigation canals for farmers whose farm land is far from the rivers. Because it minimizes the distance from rivers and their irrigation site, consequently, creates an opportunity to shift non-users to use irrigation water in the study area. Therefore, in addition to river water, it is better to initiate farmers to develop and use water, it's harvesting technology at (pond and spring development) community and household level and shallow well at household. In this regard, the current effort of the government should promote small-scale irrigation scheme and water harvesting technologies should be further expanded and strengthened in order to enhance the income level as well as reducing the poverty status of rural farm households.
- Training had a significant and positive effect on the use of irrigation water. Therefore, governmental and nongovernmental organizations should work cooperatively to increase the access of irrigation development by giving a great emphasis on the provision of training through awareness creation and operation of irrigation technologies for the farmers that improves farmers' awareness and skill about irrigation technologies and increases their access to use irrigation water. Training should be given continuously; otherwise, a one-time training, an irregular and partial training cannot bring about a desired effect on the use of

irrigation and also the trainer should give awards and motivation to those farmers who accept and apply the training to initiate others especially to shift non-users to use irrigation activity. Institutional support towards capacitating, training, and coordinating rural cooperatives would play an inevitable role in enhancing the effect of irrigation on poverty reduction.

- Agricultural labor had a significant and positive effect on the use of irrigation water. Therefore, governmental and non-governmental organizations should give emphasis on the provision of credit for farmers and that improves their financial capital to purchase improved equipment that save time and rent labor to fill the gap of family labor shortage. Consequently, creates an opportunity to shift non-users to use irrigation water in the study area.
- Woreda and kebele agricultural office should built water committee to distribute water effectively and efficiently.
- The results of this study showed that the size of cultivated land is positively and significantly influenced the probability of use of irrigation and it was one of the most constraining factors. Thus, to mitigate the problem of cultivated land scarcity, the existing land must be intensively used. For this purpose, farmers should rather be encouraged to use intensive agricultural production methods. Additionally, non-irrigator farmers should communalize the land with those farmers who have large farm size and get access to irrigation. The government should also prepare credit access to enable those farmers who have small farm size purchase waterside for their own irrigation purpose.
- The performance of irrigation users' cooperate in managing the scheme found at low levels show a wide gap between the objective and actual implementation. Among the factors that were found to be significant are poor access to credit, inadequate training and poor market access. Designing an appropriate local institutional arrangement according to the demand and priority of each scheme which fits the specific contextual situation and minimizing the causes of institutional failure are indispensable to create a sustainable local institution for irrigation management.
- The National, Regional and local government of the country should pursuing plan and programs to develop irrigation activities to reduce poverty and create favorable atmosphere for social change.

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Appendix

Dear Respondent,

First of all, I would like to thank you for your willingness to participate in this study. The questionnaire is designed to collect the necessary information to undertake a research on the determinant of small-scale irrigation use and its implication on poverty reduction. The study is conducted for the partial fulfillment of the requirements for the degree of Master's in Water Resource Management and Development program (MSc) at Addis Ababa University.

The main objective of this research is to investigate the determinants of small-scale irrigation use and its implication on poverty reduction among smallholders. Please answer each questions by making a tick mark **(√)** to the option that you choose inside the given box or circle according to the given question or write your answer on the blank space provided. Your genuine responses are quite vital for the success of this study. Finally, I would like to confirm you that all the information you provide in this questionnaire will be strictly confidential and will exclusively use for this research purpose only.

NB. No need of writing your name. Thank you very much ahead for your cooperation!!!

Identification

a. Code _____

b. Kebele _____

c. Village_____

Section I) General Information of the Respondent

1. Sex: Male ☐ Female ☐

2. Age of the household head? ….. Years.

3. What is the Education level of household head? Illiterate ☐ Read and write ☐ junior complete ☐ High School and above ☐

4. Respondent's Religion

Christian ☐ = Muslim ☐ other _____

5. Total family size of the household in number _____

7. Type of your house Grass roofed ☐ Corrugated iron-roofed house ☐

8. What is your Occupation? Please circle your choice, More than one answer is possible.

1). farming 2).trade 3).petty trade 4) traditional healer 5).if other, please specify

8. If your answer above is farming, how many members of your family members took part in farming activity last year? _____

Section II) Economic activities related questions for both users and non-users

1. What is the major source of your household income? Please circle your choice; more than one answer is possible.

a).Irrigation farming b).Rainfed farming c). Trade d). Livestock Fattening). Others please specify …….

2. How much income you got from both farming and livestock selling last year in (birr)? ……. Birr

3. What is the total income got from off/non-farm activity for the last year?

4. What is the total size of your farming land? _____ Timad

5. What do you often use to plough your farming land? Oxen ☐ Hoe ☐ others, please specify……

6. How many ox do you have?

7. How much is the annual production from farming during rainy season? .....Quintal

8. What is the total annual income for the last year?

9. What is your food and non-food expenditure for the last year?

10. How do you rate the soil fertility of your farming land as compared with the other farming lands in your locality?

1. Very low 2. Low 3. Medium 4. High 5. Very high

Questions for irrigation users

1. How long have you been using irrigation schemes in your farming activities? Please circle your choice.

A) No irrigation farming before B).0-2 years C). 2-4 years D).4-6 years E).above 6 years

2. Did you get full access for irrigation schemes in all parts of your farming land?

a. Yes b. No

3. If you have a partial access to the irrigation schemes, what proportion of your farming land was irrigated last year or 2010 EC?

a. 0.25 timad b. 0.25-0.5 timad c.0.5- 0.75 timad d. above 0.5 timad

4. How much income earned from irrigation scheme annually? ……. Birr

5. What is the total food and non-food expenditure annually?

5. What are the major problems you face/observe in your irrigation farming _____?

6. What actions have you taken to solve the problem

_____

7. Is there any failure in your irrigation water once constructed? 1. Yes 2.No

8. If there are a frequent failure what was the main reasons _____

Water distribution mechanism for irrigation users

1. Is there irrigation water use association around your area? 1. Yes 2. No

2. If your answer is yes, what are the benefits you have obtained from the association?

3. Do you take part in managing the irrigation schemes? 1. Yes 2. No

4. If your answer is yes to the above question, what is your role_____?

5. Is there any rules and regulation to distribute water for the user in effective and efficient way? A). Yes B). No

6. If the answer is yes please explain your mechanism to distribute irrigation water to the users_____

7. What is the system of water sharing with others?_____

_____

8. How many days do you irrigate your land in a week during dry season? ___ days

9. Is the amount of water enough to irrigate your land? Yes ☐ No ☐

10. If your answer is no, what mechanisms do you suggest to solve the scarcity of water_____

Questions on the Implication of small-scale irrigation to poverty reduction

The questions under this section focus on the contribution of small scale irrigation on poverty reduction in relation to change in income levels, food security, employment generation, type of production asset building among irrigation users.

1. To what extent do you agree that SSI contributes to reduce poverty through increasing the type of production by using irrigation scheme? Please indicate your agreement or disagreement regarding the factors influencing the performance of SSI at Bogena irrigation scheme: 1= strongly disagree 2=Disagree 3=moderately agree 4=Agree 5=strongly agree.

No	**Contribution of SSI use**	**Choice**				
		1	2	3	4	5
9.1	The income of irrigation users has increased					
	Small scale irrigation provide additional benefit such as getting additional income by selling maramar grass, fodder for livestock,					
	Created additional food sources for consumption at the household level and the like					
	Small scale irrigation increase cattle production					
	using Small scale irrigation reduced indebtedness					
	Small-scale irrigation increase living standard of irrigation user household.					

Questions for irrigation non- users

Factors that influence on small-scale irrigation use among smallholders

1. The questions under this section focus on the challenges smallholder farmer face to use irrigation schemes. The questions are presented under four sub-sections. That is factors related with the social, economic, institutional and environmental concerns.

   Under each of the factors, various statements are presented. In your opinion, which item is the most important challenges under each of the factors? Please read all items under each of the four factors first and rate the most important challenges by using the following choice

   1= strongly disagree 2=Disagree 3=uncertain 4= Agree 5=strongly agree

   I have not been using the irrigation scheme due to the following challenges

No	Social factors	Choice	
		Yes	No
1.1	Lack of adequate man power in the household		
	Small family size		
	The gender of the household head (i.e. female headed household)		
	Old age of the household head		

No	Economic factors	Choice	
		Yes	No
1.2	Land holding size		
	Lack of oxen		
	Lack of Market access		

No	Institutional factors	Choice	
		Yes	No
1.3	Low access to credit		
	Low access to extension service		
	Low access to Training		

1.3.1. How many times do you contact with development agents within a month?

a).greater than 4 times within a month b). 2-4 times within a month c).less than 2

No	Environmental factors	Response				
		Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
1.4	Water availability in the farm land					
	distance from water source					
	The terrain of the farm land is not suitable for irrigation					
	If other, explain…….					

1.4.1. What is the terrain of farming land?

A). Suitable for irrigation B). Unsuitable for irrigation

Section V) Focused group discussion

Checklists for focus group discussion for irrigation users.

1. How do you manage your irrigation system (construction, maintenance, operation activities, water allocation, distribution, drainage etc)?
2. In your opinion, how do you judge the implication of irrigation for household poverty reduction?
3. How do you see the institutional support you get from governmental offices in use of irrigation schemes?
4. What are the common problems of the irrigation scheme?

Checklists for focus group discussion for non-irrigating households

1. What are the major factors affecting in irrigation activities in your area?
2. Why do you prefer rain fed agriculture?
3. Is status of the annual income and expenditure of the household proportional for each year?
4. Is there any difference in living standard of households between irrigation users and non-users?

Section VI) Key informants Interview

Checklist for key informants on the irrigation scheme and beneficiaries

1. How irrigation is managed (design, construction, operation and maintenances, water distribution rules and regulations)
2. What do you think the major factors affecting in SSI use among smallholders in the river catchment?
3. What do you think about the main problems facing in irrigated farmers?
4. What measures undertake to tackle those problems faced in the study kebele?
5. What are the supports provided by you and your organization for irrigation users?
6. What do you suggest about the contribution of irrigation for poverty reduction?
7. Is there any irrigation policy applied in your irrigation site?
8. Describe the general transport and marketing channel available to the farmer?

_____

9. List crop varieties grown by farmers

10. What role does the government play in irrigation farming along Bogena irrigation scheme?

Summary of continuous variables

Variable	User		Non-user		Total		t-value
	N	%	N	%	N	%	
Age of household head							
20-40	21	25	11	13.1	32	29	
41-60	48	57.1	32	38	80	47.6	
61-80	15	17.9	41	48.8	56	33.3	
Mean (SD)	40.2(11.09)		44.5(11.9)		42.13(11.68)		2.15**
Family labor	3.63(1.37)		2.73(0.93)		3.18(1.24)		5.00***
Dependency ratio	1.25(1.07)		1.51(1.11)		1.38(1.07)		-1.59
Oxen ownership	1.21(0.68)		0.92(0.78)		1.07(0.74)		2.6***

and * represents at 5% and 1% significant level respectively.

Source: field survey, 2019